Energy, Mines and Resources Canada
Énergie, Mines et Ressources Canada

Polar Continental Shelf Project

Titles and Abstracts of Scientific Papers Supported by PCSP

No. 5

compiled by
G.D. Hobson and J. Voyce

1983

Canada

Published under the authority of the
Minister of Energy, Mines and Resources,
Government of Canada

© Minister of Supply and Services Canada 1983

Cat. No. M78-5/5-1983E

ISBN 0-662-12570-3

PREFACE

In 1970, 33 parties were supported in the Canadian Arctic by Polar Continental Shelf. In 1980 that number had grown to 166 indicating a vastly greater interest in and concern for science in the Arctic. The level of activity has held on this same high plateau for the last three years and will probably increase in 1983. Scientists of Federal government agencies have convinced, or been convinced by, their masters that science in the Arctic is necessary and is "good" for Canada and indeed for the rest of the world. Knowledge of the Canadian Arctic spins off to many unexpected areas of science - not all pertinent directly to Canada's requirements, but of profound interest to world scientists. I think specifically of the oceanographic and climatological studies which are an integral part of hemispheric and global studies. There are other disciplines with equal impact. We are not operating in a vacuum or in our own little world.

Volume 5 of the P.C.S.P. bibliography contains 407 items bringing the total to 2223 papers and abstracts published as a result of PCSP support. Many other projects have passed through our hands that have been supported in various ways but do not warrant or require public reporting. This bibliography is now believed to be one of the more complete accounts of science undertaken in the Canadian Arctic since 1960.

The contributions of the principal investigators whom we support are appreciated and indeed expected as a condition of our support. As long as this bibliography fulfills a requirement we shall continue to publish it.

March 1, 1983

En 1970, l'Étude du Plateau Continental Polaire aidait à 33 équipes. En 1980 ce nombre s'élevait à 166, marquant un plus grand intérêt dans la participation des sciences dans l'Arctique.

Les niveaux d'activités ont été soutenu à la même hauteur pendant les trois dernières années et seront probablement augmentés en 1983. Les scientifiques des agences du gouvernement fédéral ont persuadés, ou ont été persuadés par leurs supérieurs, que dans l'Arctique, la science est nécessaire et bonne pour notre pays, et certainement pour le reste du monde. Les connaissances de l'Arctique canadien dénouent trop de secteurs scientifiques inattendus qui ne sont pas tous appropriés aux exigences du Canada, mais d'intérêts profonds aux scientifiques à travers le monde. Je pense surtout aux études dans les disciplines de l'océanographie et climatologie qui font une partie intégrale des études hémisphériques et du globe. À mon avis, il y a d'autres disciplines qui portent autant d'impact. Nous ne fonctionnons pas dans le vide out seulement dans notre petit monde.

Volume 5 de la bibliographie de l'Étude du Plateau Continental Polaire contient 407 items amenant au total 2223 articles et abstraits publiés à cause de l'aide reçue par EPCP. Plusieurs autres projets ont passé entre nos mains, leurs donnant notre appui, mais ne justifiant ou ne requierant un reportage publique. Nous croyons que cette bibliographie est une des plus complète des événements entrepris dans l'Arctique canadien depuis 1960.

Les contributions des investigateurs principaux, auxquels nous offrons notre appui, sont appréciées et même constitues une condition préalable pour notre aide. Tant que cette bibliographie comblera une demande, nous continuerons à la publiée.

le 1 mars, 1983

CONTENTS

Page

Preface iii

Archeology 1
Bathymetry 8
Biology 8
Botany 23
Climatology 28
Equipment 31
General 33
Geology 36
Geophysics 64
Glaciology 70
History 73
Hydrography 73
Hydrology 73
Oceanography 76
Oil Spills 80
Sea Ice Research 80

Author Index 85

ARCHEOLOGY

1814 ARNOLD, C.D. - 1979
Possible Evidence of Domestic Dog in a Paleoeskimo Context; *Arctic*, vol. 32, no. 3, pp. 263-265.

Domestic dogs played a significant role in the adaptive strategies of most historic Inuit and their archaeological predecessors, the Neoeskimo. Although the earlier Paleoeskimo cultures occupied the same environment and exploited many of the same resources as the historic Inuit, there is only sporadic evidence for domestic dogs in Paleoeskimo contexts. There appears to be little doubt that some of the Canidae remains from the Ipiutak site at Point Hope, Alaska, are those of domestic dog. Meldgaard has inferred the presence of domestic dog earlier in a Paleoeskimo Pre-Dorset component at Igloolik, N.W.T., but recently that interpretation has been challenged. According to Maxwell the earliest acceptable evidence for a domestic form of Canidae in a Paleoeskimo context in the eastern arctic occurs at the Dorset Nanook site on southern Baffin Island. The Nanook site appears to date no earlier than the first or second century A.D., roughly contemporary with Point Hope Ipiutak.

1815 ARNOLD, C.D. - 1980
Archaeological Reconnaissance on Southeastern Banks Island and Northern Victoria Island, 1980; *Polar Cont. Shelf Proj.*, internal report, 90 p.

The archaeology of Banks Island, and of the western Canadian Arctic as a whole, is essential to an understanding of prehistoric developments in arctic Alaska and the eastern Canadian Arctic. The latter two areas have witnessed fairly intensive research, and each has a corpus of data interpreted in terms of discrete cultural-historical frameworks which are bridged only sporadically, and even then briefly. Our picture of these widely-separated regions as discrete sub-culture areas may, however, be a product more of archaeological endeavour than of past cultures. Recent work elsewhere on Banks Island, which is geographically intermediate, has revealed a degree of cultural continuity between Paleoeskimo cultures of arctic Alaska and the Canadian Arctic previously unsuspected, and has raised the possibility that, as data accumulate from the western Canadian Arctic, cultural continua will be recognized for other time periods as well. If that proves not to be the case, we are faced with yet another intriguing problem: why the continua did not exist.

The study area extends from DeSalis Bay in the northeast, to Nelson Head in the southwest.

Most of our objectives were met. Intriguing archaeological remains were encountered in each of the three survey areas. Those in the Nelson River area in particular are considered to be pertinent to the theme of the Banks Island Archaeological Research Project, and a second season of research in that area is planned.

1816 ARNOLD, C.D. - 1980
A Paleoeskimo Occupation on Southern Banks Island, N.W.T., *Arctic*, vol. 33, no. 3, pp. 400-426.

Significant changes occurred within Paleoeskimo cultures during the first millenium B.C. Archaeological remains from the Lagoon site, on Banks Island, N.W.T., provide a new perspective on the nature of those changes and insights into some of the processes involved.

1817 BIELAWSKI, E., and COLE, S. - 1979
Heritage Education: The First Season of the Northern Cultural Heritage Project; *Prince of Wales Heritage Centre*, internal report, 54 p.

The Northern Cultural Heritage Project (NCHP) evolved over a period of 3 years of Arctic archaeological research. During this time, we trained 3 young Inuit as archaeological field assistants and learned from them some of the problems facing contemporary Inuit youth. We also became aware of community concern for involvement in southern-based research. This experience, combined with our commitment to Arctic archaeological research, to developing awareness of cultural heritage, and to conservation of heritage resources led to the NCHP.

The NCHP aims to: alleviate underemployment through a training program to develop employable skills in young northerners; encourage respect for cultural heritage through an academic program in introductory Arctic anthropology; undertake archaeological research which is both problem-oriented and relevant; and alleviate local opposition and ignorance through involvement. The primary objective, therefore, is education: education of the scientist, student and community.

1818 BIELAWSKI, E., and COLE, S. - 1980
1980 Archaeological Research and Training - Stanwell-Fletcher Lake, Somerset Island, NWT; *Prince of Wales Heritage Centre*, internal report, 16 p.

In its second year of operation the Northern Cultural Heritage Project functioned as in 1979. Three returning students and four new students participated in the continuing excavation of site PfJv-2 on Stanwell-Fletcher Lake. Our goals this year were development and implementation of a systematic sampling design for the site, and continuation of the training and education program. This interim report documents the research plan for 1980 - 1982 and continued heritage education both at the site and through operation of an archaeology lab in the community of Resolute Bay.

1819 FRANKLIN, U.M., BADONE, E., GOTTHARDT, R., and YORGA, B. - 1981
An Examination of Prehistoric Copper Technology and Copper Sources in Western Arctic and Subarctic North America; *Archaeological Surv. Can.*, National Museum of Man Mercury Series No. 101, ISSN 0316 1854, 158 p.

The Results of Investigations of native copper technology and sources of native copper of the prehistoric inhabitants of the North American Arctic and Subarctic are described. A total of 342 artifacts were examined from Arctic Small Tool tradition, Thule, Historic Eskimo, Chipewyan, Kutchin, and Ahtna contexts. Investigations of technology were made using both destructive and non-destructive techniques including measurements of thickness and density, optical examination, radiography and metallography. Compositional information, intended to differentiate the various sources of native copper in the North, was obtained primarily by neutron activation analysis. X-ray fluorescence proved a useful non-destructive technique for the differentiation of native copper and industrial alloys introduced through European trade.

The study made use of a system of classification or characterization of objects in terms of their location (both archaeological and geological), techniques of manufacture, and composition to address problems of prehistoric trade in native copper and the question of the origin(s) of the native copper technology in the North. The experimental investigation showed the almost universal use of "folding" as a means to build up objects from small pieces of native copper. Microscopic examinations proved that this technique involved annealing and/or hot working and thus documented the familiarity of at least some of the northern groups with the working of copper at non-ambient temperatures. The authors suggest a rationale for the appearance of folding based on the limitations of available cutting tools.

The widespread occurrence of folding is interpreted as indicating that a shared body of knowledge existed among Indian and Eskimo groups in the North, cross cutting traditional cultural and temporal boundaries.

The variations in the trace element content of the native coppers was not sufficiently pronounced to allow the attribution of artifacts to specific geological sources.

The second part of this volume consists of an annotated bibliography of metal occurrences in the North.

1820 HELMER, J.W. - 1980
Early Dorset in the High Arctic: A Report from Karluk Island, N.W.T.; *Arctic*, vol. 33, no. 3, pp. 427-442.

Pendant les mois de Juillet et Août 1978 un programme de fouilles archeologiques se realisait sur l'ile de Karluk dans le region du detroit de Crozier (Arctique Septentrional). Le but était de recuperer suffisamment d'échantillons d'artefactes pour imposer des comparaisons inter-regionales et obtenir des données subordonnées et se rattachant à des types de structure, à des modes de subsistance et des données d'occupation saisonière.

Sur tout les systemes de grandes terrasses, en bordure de plage, il est evident qu'il y a eu occupation humaine, cela à des altitudes de 2 à 23 mètres, pendant environ 4000 ans de prehistoire correspondant à l'époque de Thule, celle des outils arctiques en pierre. Des vestiges d'age Dorset précoce se situent sur des plages anciennes, actuellement à une altitude de 8 à 12 mètres. On a decourvert 7 sites sur l'ile de Karluk dont 6 sur la cote ouest. Malgré le printemps tardif, les objectifs de recherche étaient largement atteints en 1978. Dans 8 emplacements fouillés, 892 artefactes étaient inventoriés, 41 étaient recuperés de 5 types; 1300 fragments d'os d'animaux étaient ramassés (phoque, morse, caribou, boeuf musqué, renard arctique, lemming et plongeur arctique). Les sites les plus voisins d'aspect sont celui de la culture d'Independence 2, d'affiliation Pre Dorset tardif et d'autres d'age Dorset précoce, sont de 3000 à 2500 ans avant notre ere.

Des comparaisons du materiel peuvent se faire avec celui de l'Arctique central, à partir des sites de l'ile de Victoria, d'age Dorset précoce à moyen, en continuité, et aussi avec l' Arctique oriental (site de Tyara). Deux datations au carbone 14, à partir d'os de boeuf musqué de l'ile de Karluk, d'age Dorset précoce, donnent un age de 2205 ± 120 ans avant notre ere 2995 ± 70 ans à partir de bois flotté.

Les considerations ecologiques et la hauteur relative du site suggerent que cette dernière datation est d'age trop ancien. L'age calculé est celui de bois et non celui du site. L'autre datation est acceptable. Ces decouvertes etendent vers le nord d'environ 600 kilometres l'aire d'extension de la civilisation Dorset précoce et comble un creneau chronologique et typologique de la séquence de l'Arctique septentrional. Il y a deux hypothèses au sujet de l'occupation Dorset précoce dans la region du detroit de Crozier, celle d'un temoin de migration, hors de l'Arctique de centre-est, ou celle d'une occupation permanente dans l'Archipel arctique. L'auteur pense que la seconde hypothése parait plus plausible.

1821 HELMER, J.W. - 1980
Preliminary Report of the 1979 Crozier Strait Archaeology Project; *Polar Cont. Shelf Proj.*, internal report, 49 p.

The data are presented in three parts. Part One describes the results of the excavation of several early and late Dorset components on Karluk Island. Part Two summarizes the survey data from the preliminary aerial reconnaissance of the Crozier Strait area and the subsequent ground survey of Markham Point, the location selected for a mid-season camp move. Part Three describes the results of the test excavation of a variety of sites discovered on Markham Point.

1822 HICKEY, C.G. - 1978
Preliminary Report of an Archaeological Survey of North-Central Banks Island, N.W.T., Summer, 1978; *Polar Cont. Shelf Proj.*, internal report, 61 p.

The aim of the project was to search for and investigate the contents of protohistoric Copper Eskimo sites on the island.

According to ethnographic sources, Northern Copper Eskimos moved onto Banks Island (at least seasonally) between ca. 1853 and 1890 in order to salvage valuable wood and metal from the abandoned Royal Navy vessel H.M.S. *Investigator*. The *Investigator* had been part of the Franklin Search expeditions, and after spending three winters locked in the ice it had been deserted in the spring of 1853. Stefansson's informants told him that the *Khangiryuachiakmiut* of northwestern Victoria Island had soon learned of the wreck and exploited it until it was either used up, sank, or drifted away (this is unclear). In any case, Banks Island was deserted once again except for its south eastern coastal margins until perhaps the 1920's.

1823 MARY-ROUSSELIÈRE, G. - 1979
The Thule Culture on North Baffin Island: Early Thule Characteristics and the Survival of the Thule Tradition; *in* Thule Eskimo Culture: An Anthropological Retrospective, ed. A.P. McCartney, National Museum of Man Mercury Series, Archaeological Surv. Can. Paper No. 88, pp. 54-75.

Recent excavations at the large Thule site of Nunguvik, Navy Board Inlet, provide evidence for an early and long Thule occupation on northern Baffin Island. Thule artifacts, houses, graves, and radiocarbon dates from this site are discussed in the context of Thule culture as it is represented at surrounding sites. A strong Thule-to-modern Iglulik Eskimo cultural continuum is noted for this area.

1824 McCARTNEY, A.P. - 1978
Study of Archaeological Whale Bones for the Reconstruction of Canadian Arctic Bowhead Whale Stocks and Whale Use by Prehistoric Inuit; *Polar Cont. Shelf Proj.*, internal report, 138 p.

Archaeological whale bones at Thule Inuit winter sites in the central Canadian Arctic are direct evidence of the prehistoric whale population of approximately A.D. 1000-1300. Measurements and other osteological observations on these bones may be used to ascertain the species, sizes, and ages of whales extant, as well as selectivity of the archaeological sample from the original regional whale population. No comparable quantitative data for bowheads have been collected to characterize the pre-whaling stocks in the Canadian Arctic. Ethnographic/ethnohistoric and historic documents of the whaling period do not provide comparable information about prehistoric whales and their availability to Inuit hunters and house builders.

Proposed research includes: (1) consultation with whale experts at the Arctic Biological Station (Ste. Anne de Bellevue), National Museum of Natural Science (Ottawa), Smithsonian Institution (Washington, D.C.), and the Los Angeles County Natural History Museum about whale osteology and measurement, as well as inspection of whale osteological collections at the first three institutions; (2) development of computer coding sheets suitable for collecting field data from bones; (3) field work on Somerset Island, N.W.T., for a period of three weeks in July and early August to measure whale bones and to make other relevant osteological observations; (4) analysis of collected data using computer-derived regression analyses at the University of Arkansas; and (5) preparation of a report about the data and archaeological/biological interpretations by early fall, 1978.

1825 McCARTNEY, A.P. - 1979
Archaeological Whale Bone: A Northern Resource; First Report of the Thule Archaeology Conservation Project, ed. A.P. McCartney, *Univ. Arkansas*, Anthropological Papers No. 1, 558 p.

Over the past decade, Inuit carvers have removed large amounts of bowhead whale bones from Thule winter sites to be transformed into sculpture for worldwide marketing. The extensive and acute impact of whale bone loss and site damage has been studied by the Thule Archaeology Conservation Project. Project crews assessed site damage, excavated whale bone sites, and promoted Inuit participation and archaeological training in the central and eastern Canadian Arctic between 1975 and 1977.

This volume is the first of two reports about the project's operations and findings. Chapters cover the development of the whale bone carving industry, whale bone evaluations, mitigation alternatives and recommendations, site surveys, preliminary results of site excavations, and a Thule winter site inventory. A Thule bibliography is also included.

Our 1976 excavation experience shows that limited but expensive archaeological excavations cannot provide sufficient whale bones to support the annual carving production of 1969-1973, estimated to be 40 tons per year. For this reason, and because whale bone carving eliminates the possibility of ever understanding the cultural aspects of past whale bone use and of modern Inuit appreciating its significance, we recommend that alternative carving materials be promoted.

1826 McCARTNEY, A.P. - 1979
Thule Eskimo Culture: An Anthropological Retrospective, ed. A.P. McCartney, National Museum of Man Mercury Series, *Archaeological Surv. Can.* Paper No. 88, 586 p.

This volume is the proceedings of a symposium devoted to Thule archaeology and related northern studies, held at the 10th annual meeting of the Canadian Archaeological Association in Ottawa during May, 1977. The 31 papers variously address Thule chronology and culture history, prehistoric-recent continuities, adaptation and climatological relationships, site interpretations, technology and art, human biology, and history of archaeological development. Whereas the Thule cultural tradition may be traced back two millennia to the Bering Strait area of Alaska, these papers focus on the last thousand years of Neo-Eskimo cultural evolution in Alaska, Canada, and Greenland.

Thule people in the latter two countries date to a general population and corresponding cultural spread eastward from the Beaufort Sea coast beginning about A.D. 1000. Modern Canadian and Greenlandic Inuit are the direct descendants of these prehistoric bearers of Thule culture.

1827 McCARTNEY, A.P. - 1979
A Processual Consideration of Thule Whale Bone Houses; *in* Thule Eskimo Culture: An Anthropological Retrospective, ed. A.P. McCartney, National Museum of Man Mercury Series, Archaeological Surv. Can. Paper No. 88, pp. 301-323.

Whale bone houses that characterize early Thule culture in the Canadian Arctic tend to be studied as static constructions. In fact, these houses represent at least six major stages of human behavior and natural modification: material procurement, construction, use, possible reuse, abandonment, and post-occupation erosion. Examples of systemic Thule Inuit behavior are given for these stages of house evolution. Early Thule sites on Silumiut and Somerset Islands, N.W.T., are used to demonstrate these stages. A contemporaneous but undisturbed whale bone house excavated on the Alaska Peninsula contrasts with the severely altered Canadian Thule houses. Archaeologists are urged to study Thule houses as patterned representations of past Inuit behavior as well as normative constructions.

1828 McCARTNEY, A.P. - 1980
The Nature of Thule Eskimo Whale Use; *Arctic*, vol. 33, no. 3, pp. 517-541.

Archaeologists for the past half century have considered bowhead whaling to be an important and integral part of Thule Eskimo subsistence. This position has come into question recently. Arguments are set forth favoring the predominant archaeological view that bowheads were hunted and extensively used during the period A.D. 1000-1300 in much of the Canadian Arctic. Direct, indirect, and circumstantial evidence is outlined, ranging from the presence of whaling gear and graphic whaling depictions to arguments of resource maximization and ample storage capacity at Thule winter sites. Differences in interpreting the Thule record appear to reflect different methodological approaches of ethnologists and archaeologists.

1829 McCARTNEY, A.P. - 1980
Study of Archaeological Whale Bones for the Reconstruction of Canadian Arctic Bowhead Whale Stocks and Whale Use by Prehistoric Inuit; *Polar Cont. Shelf Proj.*, internal report, 165 p.

This 1978-1980 whale bone project focused on three major themes, all relevant to archaeologists, whale biologists, and other students of the Canadian Arctic: 1) the descriptive/metric characterization of archaeological bowhead (*Balaena mysticetus*) bones by size and age, 2) the use of whale bones as construction elements in semi-subterranean winter houses, and 3) cultural selection of bowheads prehistorically and the impact that such selection had on the Davis Strait bowhead stock. Archaeologists have been cognizant of Greenland or bowhead whale bones at Canadian Thule Eskimo sites (c. A.D. 1000-1300) for the past 50 years, but such bones, in the main, have only been viewed as evidence for winter house construction or whale hunting. To our knowledge, no prior attempt has been made to establish the size/age profile of these bones to better understand hunting and use selection. Conversely, whale biologists have paid little attention to archaeological whale bones, other than acknowledging their presence, in studying the historic-to-modern Canadian whale stocks. Neither distribution of bowhead bones throughout the Canadian Arctic as range data nor the relevance of such bones in estimating prewhaling stocks has been emphasized. It is hoped that the relic evidence of once abundant bowheads found at Thule winter sites, on which this analysis centers, will become useful to a wider scientific and lay audience in the future.

This final report covers the analysis of bowhead measurements and observations taken in the field during 1978, as well as the osteological and behavioral results of their study. The report forms the final "chapter" to the project's preliminary report.

1830 McCARTNEY, N.G. - 1978
Lichens from Three Archaeological Sites, Somerset Island, N.W.T., Canada; *The Bryologist*, vol. 81, no. 4, pp. 610-613.

Fifty-four species of lichens are reported from three archaeological sites from coastal lowlands on Somerset Island. Most are new to this island. The uniqueness of archaeological sites in lichen studies is emphasized.

1831 McGHEE, R. - 1979
Archaeological Excavations at Brooman Point, Bathurst Island, Summer 1979; *Polar Cont. Shelf Proj.*, internal report, 19 p.

The 1976 work indicated that the Thule site was of a relatively early date, while the Dorset site represented the last phase of Dorset occupation in the area. The finding of a Thule knife handle on the floor of the only Dorset house excavated that summer suggested that we might hope to discover evidence indicating contact between the two populations, something which has yet to be demonstrated on any Arctic site. By further excavation we also hoped to more precisely define the dates and natures of both Dorset and Thule occupations of the site.

1832 McGHEE, R. - 1979
The Palaeoeskimo Occupations at Port Refuge, High Arctic Canada; National Museum of Man Mercury Series, *Archaeological Surv. Can.* Paper No. 92, ISSN 0317-2244, 176 p.

Port Refuge (RbJu-1) is a small bay on the south coast of Grinnell Peninsula, Devon Island, in High Arctic Canada. Archaeological work between 1972 and 1977 recovered remains of several prehistoric occupations of this area, which are ascribed to the Independence I, Pre-Dorset, Independence II/early Dorset, late Dorset and Thule cultures. The present report describes the archaeological material relating to the early Arctic Small Tool tradition occupations. Five components are ascribed to an Independence I variant, and one to a Pre-Dorset variant of the ASTt. The Independence I components comprise between 13 and 31 discrete features, most of which appear to have been single family tent dwellings of the midpassage form; faunal analysis suggests that these dwellings were occupied for periods of time ranging from a few days to a few weeks, by people who were engaged primarily in hunting ringed seals, waterfowl and fox. The single Pre-Dorset component appears to represent a more lengthy occupation, but the faunal remains suggest an economic orientation similar to that of the Independence I people. A brief attempt is made to understand the relationships between the Port Refuge people and ASTt people in other Arctic areas, and to explain the nature of this earliest occupation of the Port Refuge area.

1833 McGHEE, R. - 1980
Archaeological Excavations at Brooman Point, Bathurst Island, Summer 1980; *Polar Cont. Shelf Proj.*, internal report, 14 p.

We completed the excavations of four large Thule houses opened in 1979, opened and completed excavations of five smaller Thule houses, did limited excavations in the extensive Dorset middens surrounding the Thule village, and a small amount of work on early Dorset/Independence II and earlier ASTt components in the vicinity of the site. Finally, in a brief helicopter survey we visited the three other known Thule villages in the Crozier Strait area in order to get some preliminary idea on whether or not excavation would be useful at these sites.

1834 McGHEE, R. - 1980
Individual Stylistic Variability in Independence I Stone Tool Assemblages from Port Refuge, N.W.T.; *Arctic*, vol. 33, no. 3, pp. 443-453.

Typological comparisons of stone tool assemblages have traditionally been seen as a means of assessing the relationships between components within the Arctic Small Tool tradition (ASTt). Excavation at Independence I components at Port Refuge, Devon Island, allows us to examine this assumption. These components consist of spatially discrete features, most of which appear to be the remains of single family dwellings occupied only once and for a short period of time. It can probably be assumed that the majority of artifacts associated with any feature were manufactured by the individuals who occupied that feature. Marked differences can be seen between feature assemblages in the proficiency with which stone tools were made, and individual stylistic preferences can be postulated on the bases of intra-feature uniformities. If the hypothesis ascribing a great deal of stylistic variability to individual ability and preference is correct, typological comparisons of Canadian ASTt stone tool assemblages may be of relatively little use in judging the relationships between components.

1835 McGHEE, R. - 1980
Technological Change in the Prehistoric Eskimo Cultural Tradition; *Can. J. Archaeology*, no. 4, pp. 39-52.

The prehistoric cultures of Arctic North America provide a unique opportunity for anthropological study. Here, in the regions north of the treeline, lived peoples whose archaeological remains are relatively well preserved to the present day. Archaeological sites are more visible, and have suffered less from destruction, than those in more temperate regions. Archaeological interpretations are facilitated by the fact that prehistoric Arctic peoples lived in relative isolation from peoples with other cultural traditions; that the Arctic environment has drastically limited the range of prehistoric economic adaptations; and that we have a relatively extensive ethnographic knowledge of the peoples whose cultural ancestors left many of the remains which we are seeking to interpret. Archaeology should, therefore, be capable of recovering a more complete picture of prehistoric life in Arctic North America than in most other areas of the world.

1836 McGHEE, R. - 1981
The Dorset Occupations in the Vicinity of Port Refuge, High Arctic Canada; National Museum of Man Mercury Series, *Archaeological Surv. Can.* Paper No. 105, ISSN 0317-2244, 129 p.

This report describes the findings of archaeological work between 1972 and 1977 related to Independence II and Dorset cultures, both on the south coast of Grinnell Peninsula and on adjacent Dundas Island. Twelve components, comprising over 50 dwelling structures, are assigned an Independence II affiliation. Limited excavation suggests that these sites were occupied by people engaged primarily in hunting Ringed seals, and that their technology was most similar to that of Independence II culture of northern Greenland, while bearing some resemblance to Early Dorset culture in Arctic Canada. Late Dorset occupation was encountered primarily on Dundas Island, 20 km to the south of Port Refuge, where one of four small villages was completely excavated. More limited Late Dorset occupations occurred in Port Refuge, and at Hornby Head 30 km to the east. These people appear to have hunted seal, walrus and bear, and their technology very closely resembles that from late Dorset sites excavated in other parts of Arctic Canada. No cultural continuities are seen between these two periods of occupation, and it is suggested that the Port Refuge area was unoccupied during most of the time when Dorset culture flourished in the Low Arctic. Port Refuge is characterized as an area marginal to Palaeoeskimo occupation, occupied only during periods when widespread expansion of Paleoeskimo cultures occurred.

1837 McGHEE, R. - 1981
A Tale of Two Cultures: A Prehistoric Village in the Canadian Arctic; *Archaeology*, vol. 34, no. 4, July/August, pp. 44-51.

This village, known as the Brooman Point Village, represents a potentially exciting intersection of the only two High Arctic lifestyles known to archaeologists. During the summers of 1979 and 1980, a field party from the National Museums of Canada excavated the site in an attempt to establish the age, duration and nature of the Thule occupation, which seems to have been heaviest at some time during the eleventh or twelfth centuries after Christ. The results of the excavations have brought into clearer focus the lifeways of both the Thule and Dorset peoples. They have also clarified the overall settlement pattern at Brooman Point, which even prior to the establishment of the village had been successively occupied by various hunting parties over the course of many centuries.

1838 McGHEE, R. - 1981
The Tuniit: First Explorers of the High Arctic; *Archaeological Surv. Can.*, National Museums of Man Cat. No. NM92-76/1981, ISBN 0-660-50280-1, 72 p.

Who were these Tuniit? Where did they come from? What brought them to the High Arctic, probably the coldest and bitterest land ever occupied by humans? And how did they manage to survive?

Combining archaeological study with a vivid and searching imagination, the author attempts to answer these questions.

1839 MÜLLER-BECK, H. - 1979
Das Ökosystem der Moschusochsenjägerstation Umingmak; *in* Marburger Geographische Schriften, eds. A. Pletsch and C. Schott, vol. 79, ISSN 0341-9290, ISBN 3-88353-003-4, pp. 97-112.

1840 MÜLLER-BECK, H. -
Zur Archäologie der amerikanischen Arktis; *in* Beiträge zur Allgemeinen und Vergleichenden Archäologie, Band 1, Deutsches Archäologisches Institut, pp. 223-246.

1841 PHILLIPS PARMENTER, C., BURNIP, M., and FERGUSON, R. - 1978
Preliminary Report of the Second Season (1977) of Historical Archaeological Investigations in the High Arctic; *Parks Can.*, Ind. and Northern Affairs, Nat. Historic Parks and Sites Br., Vol. I - pp. 1-279, Vol. II - pp. 280-551. *RESTRICTED CIRCULATION*

In the summer of 1977 the second season of the National Historic Parks and Sites Branch of the Department of Indian and Northern Affairs investigations of historical archaeological sites in the High Arctic was undertaken by a crew of four archaeologists and one conservator. With the assistance and support of the Polar Continental Shelf Project, Department of Energy, Mines and Resources, ten sites were visited and recorded. Sites were located on Baffin, Somerset, Devon and Ellesmere Islands and included depots, wintering camps, sledging camps, marker and message cairn sites, a shipwreck site and a whaling station. The sites date from the period between the 1820s and the turn of the 20th century and involve British, American, Canadian and Norwegian polar exploration.

1842 PHILLIPS PARMENTER, C., and BURNIP, M. - 1980

Historical Archaeology in the Eastern High Arctic; *Parks Can.*, Res. Bull. No. 137, August 1980, 21 p.

To date, twenty-six sites have been recorded; six of these were added during 1978. Located on Beechey, Baffin, Somerset, Cornwallis, Melville, Devon and Ellesmere Islands, the sites span the full range of high arctic exploration from Parry's 1824 wintering quarters to the modern expeditions of the 1920s and 1930s.

Despite attempts to increase the public's awareness of the significance of these sites, the destruction caused by uninformed visitors continues. For example, since the introduction of this project in 1976, the Franklin camp on the west end of Beechey Island has been badly disturbed - by aircraft who have recently begun landing on some of the structural remains. Without adequate protection, this damage can be expected to continue. The recent increase in scientific and commercial activities in the high arctic has caused more serious damage to these sites than have natural factors in the first 100 to 150 years. Now, visits to many of the sites are included in package tours to the arctic. There will soon be little left of these historic sites for future study.

1843 PHILLIPS PARMENTER, C. - 1980
Visibility One-Diagonal-Eight in Snow: High Arctic Historical Archaeology, 1979 Season; *Parks Can.*, Res. Bull. No. 139, August 1980, 12 p.

The project is an attempt to record the remains left by the High Arctic explorers in the 19th and early 20th centuries; sites which include cairns, caches, wintering camps, scientific stations, overnight camps, graves and memorials. The sites are unfortunately very visible on the barren arctic terrain and thus are vulnerable to destruction with the increased scientific and commercial activity now occurring in the Canadian Arctic.

1844 PHILLIPS PARMENTER, C. - 1980
Northern Ellesmere Island Historical Archaeology: Preliminary Report of the 1979 Season of the Arctic Project; *Parks Can.*, Ind. and Northern Affairs, Nat. Historic Parks and Sites Br., 330 p. *RESTRICTED*

Historical archaeological investigations of the Arctic Project were continued on northern Ellesmere Island in 1979 with the assistance of the

Polar Continental Shelf Project, Department of Energy, Mines and Resources, the Government of the Northwest Territories and Parks Canada, Prairie Region. Extant recording of the standing structures at Fort Conger was completed along with a site plan. Limited surface recording and test excavations were undertaken. The sites of Crane City and Porter Bay were mapped, recorded and surface collected. Helicopter surveys were conducted along the northern Ellesmere Coast and in the vicinity of Fort Conger.

1845 SAVELLE, J.M. - 1981
The Nature of Nineteenth Century Inuit Occupations of the High Arctic Islands of Canada; *Études INUIT Studies*, Univ. Laval, Québec, vol. 5, no. 2, pp. 109-123.

The generally held belief that the High Arctic Islands of Canada were abandoned during post-Thule times as a result of deteriorating climatic conditions has recently been questioned, with an alternative presented that suggests, at least during the 19th century, substantial Inuit occupations of this area. However, a detailed examination of relevant ethnohistorical literature and consideration of recent archaeological investigations suggest that 19th century occupations of the High Arctic Islands were generally very restricted, and were primarily a response to European activities in the area.

1846 SCHLEDERMANN, P. - 1979
Norse Artifacts on Ellesmere Island; *Polar Record*, vol. 19, no. 122, Notes, pp. 493-494.

In 1977 the Arctic Institute of North America, in conjunction with the University of Calgary, initiated an archaeological research project on the east coast of Ellesmere Island, NWT, sponsored by the Humanities and Social Sciences Division, Canada Council and the Polar Continental Shelf Project. The Ellesmere Island Research Project has as its primary goal the investigation of prehistoric cultural and ecological developments in an area which probably served as one of the primary crossing points to Greenland for various Eskimo groups. The study area comprises the Bache Peninsula region and Sverdrup Pass, which may have been used as a convenient migration route between western and eastern Ellesmere Island.

1847 SCHLEDERMANN, P. - 1980
Notes on Norse Finds from the East Coast of Ellesmere Island, N.W.T.; *Arctic*, vol. 33, no. 3, pp. 454-463.

During the 1978 and 1979 field seasons in the Bache Peninsula region on the east coast of Ellesmere Island, a number of artifacts mostly of European manufacture and presumably related to Norse activities was located in old Thule culture winter house ruins.

The finds were made on three sites in the study area. Skraeling Island (chain mail sections, knife blades, boat rivets, iron point and copper pieces, woolen cloth), the Eskimobyen site on Knud Peninsula (barrel bottom, box section, copper piece), and Haa Island (ivory figurine). A general description of these finds, locational data, associated radiocarbon dates and material analyses are presented. Specific site maps and house localities are on file with The Arctic Institute in preparation for publication.

1848 SCHLEDERMANN, P. - 1980
Polynyas and Prehistoric Settlement Patterns; *Arctic*, vol. 33, no. 2, pp. 292-302.

In traditional Inuit society the availability of game resources must always have been one of the most important criteria for the determination of settlement locations. A number of ecological factors determine the availability of particular game species in the Arctic regions. The presence of open water areas known as polynyas is one of these factors. The relationship between polynya distributions and prehistoric settlement patterns in the High Arctic is explored, with particular reference to the Bache Peninsula region on the east coast of Ellesmere Island, N.W.T.

1849 SCHLEDERMANN, P., and McCULLOUGH, K. - 1980
Western Elements in the Early Thule Culture of the Eastern High Arctic; *Arctic*, vol. 33, no. 4, pp. 833-841.

Excavations of Thule culture winter sites in the Bache Peninsula region on the east coast of Ellesmere Island have yielded a number of finds which indicate a strong relationship to cultural developments in the Bering Sea region. Specific elements under discussion include dwelling styles, clay pottery, needle cases, a brow band and harpoon heads. Evidence is presented suggesting an initial arrival of the Thule culture Inuit in the eastern Arctic around 1050 A.D.

1850 SUTHERLAND, P.D. - 1980
Archaeological Excavation and Survey on Northern Ellesmere Island and Eastern Axel Heiberg Island, Summer 1980: a preliminary report; *Polar Cont. Shelf Proj.*, internal report, 43 p.

Survey work carried out in June, 1977 on northern Ellesmere Island and eastern Axel Heiberg Island revealed a number of archaeological sites, both Paleoeskimo and Thule Eskimo, which were judged to be worthy of further investigation.

The general objectives of the 1980 field season were fourfold. First, the Westwind site (TjFD3), an Independence I settlement located in the interior of northern Ellesmere Island, was to be excavated. Second, limited excavations were to be carried out at the Buchanan Lake site (SiHw1), a Dorset/Thule settlement situated on eastern Axel Heiberg Island. Third, the Tradegood site (which is now referred to as the Remus Creek site)(SlHq3), a Thule settlement with possible Norse affiliations located on western Ellesmere Island was to be test excavated. Fourth, further survey work was to be carried out in the general vicinity of these three sites within areas that were not examined in 1977.

1851 WADE, B.J. - 1978
Manufacturing Typology for Tin Containers from the Arctic Salvage Project; Env. Can., *Parks Can.*, Manuscript Report No. 299, 103 p.

A manufacturing typology for tin containers has been developed in this paper. The tin containers used to define the types were collected during the 1976 field season of the Arctic Salvage Project, conducted by Parks Canada, Ottawa.

As a result of the study, 15 types of tin cans, four variations of tin can ends, and six types of boxes were defined.

Another result of the study was the development and definition of tin can terminology which can be used by other researchers in the future.

1852 YORGA, B.W.D. - 1979
An Archaeological Conservation Project on a Royal Navy Supply Depot, Dealy Island, Northwest Territories; *Polar Cont. Shelf Proj.*, internal report, 148 p.

The author was approached by the Prince of Wales Northern Heritage Centre with regard to a need for a rescue operation on a historic British Navy storehouse at Dealy Island in the Canadian arctic archipelago. The scene of intense activity during the search for the Northwest Passage in the 1850's, the storehouse had since fallen into disuse, with subsequent deterioration of the building and its contents. The problem of looting, and the potential loss of the site as a historic feature unique in the Canadian Arctic were sufficient cause for a large scale salvage operation.

The author was contracted by the Prince of Wales Northern Heritage Centre to act as Field Director for the 1978 season, and to implement a comprehensive rescue strategy aimed at the accomplishment of a number of objectives: a) prevention of further loss of archaeological materials to site vandals; b) estimation of the kind and quantity of archaeological materials remaining on site; c) collection of a representative sample of study materials; d) stabilization of all remaining organic, artifactual materials; e) accurate architectural recording, and stabilization of the storehouse; and f) diversion of the site drainage away from the storehouse foundations.

1853 YORGA, B.W.D. - 1980
Washout: a Western Thule Site on Herschel Island, Yukon Territory; National Museum of Man Mercury Series, *Archaeological Surv. Can.*, Paper No. 98, ISSN 0317-2244, 219 p.

The Thule occupation of the Yukon coast is poorly understood, and the area is ideally situated geographically to address the problem of Mackenzie Eskimo origins. Furthermore, environmental and historical data demonstrate the presence of a number of subsistence options capable of sustaining a relatively dense settlement pattern.

Excavations at the Washout site (NjVi-2), Herschel Island, Yukon Territory were conducted for two field seasons in order to obtain data on early Thule subsistence, and to determine the affinity of the site to later Mackenzie Eskimo occupations.

Analysis of the data indicates that the Washout site was inhabited by Western Thule peoples during a period from about 1000 - 1400 A.D. The inhabitants practiced opportunistic exploitation of seal, fish, caribou, whale and other species during the winter occupation of the site.

The Washout site is interpreted as one of a number of sites on the Beaufort Sea - Amundsen Gulf coast representing an early Western Thule expansion. Mackenzie Eskimo culture is interpreted as a distinct regional variant, derived from this Western Thule base.

BATHYMETRY

1854 MONAHAN, D. - 1979
Bathymetry of the Arctic Ocean North of 85°N Latitude - discussion; *Tectonophysics*, vol. 60, pp. 293-302.

The recent letter of Sobczak (1977) which he alleges corrects "gross errors in the position and morphology of (features) that exist on previously published maps", bears comment since nowhere does Sobczak produce evidence to indicate that his map is more worthy of consideration than any of the others which he attacks.

BIOLOGY

1855 BARRY, S.J. - 1982
Mark-Recapture Estimates for an Age-Structured, Time-Dependent Population; unpub. M.Sc. Thesis, Univ. Alberta, 103 p.

The Jolly-Seber method of analysing mark-recapture data obtained from a simple homogeneous type of population is extended to allow for some peculiarities to be present in the population. The type of population considered is non-homogeneous, consisting of only two age classes, young and adult. The young require a fixed number of years, r, in which to mature to adult status. It is assumed that only the young of the year and the mature adults are catchable, the subadults, for one reason or another, are not. This analysis assigns to the young a probability that they survive the r years to maturity and a different probability that the adults survive one year intervals. Maximum likelihood estimates for population size parameters and the survival probabilities are provided.

The estimation equations are applied to a set of capture-recapture data obtained from a colony of Pacific brant (*Branta bernicla nigricans*) breeding in the Anderson River Delta in the Canadian arctic. These data were collected from 1959 to 1979 by Dr. T.W. Barry of the Canadian Wildlife Service, with the assistance of the author.

1856 BARRY, T.W., BARRY, S.J., and JACOBSON, B. - 1981
Sea-bird Surveys in the Beaufort Sea, Amundsen Gulf, Prince of Wales Strait and Viscount Melville Sound - 1980 Season; *Can. Wildl. Serv.* internal report, 69 p.

Seven surveys of birds associated with marine and coastal areas of the Beaufort Sea, Amundsen Gulf, Prince of Wales Strait and Viscount Melville Sound were flown during June through September 1980. The purpose of the surveys was to determine times and places that are important to sea-birds during the migration, nesting, molting, brood rearing and fall staging phases of their life cycles.

The habitat used by marine or sea-birds was rated according to its sensitivity to environmental impact. Estimates of the portion of species population that might be affected by possible "developmental accidents" etc. are made for various concentration points.

1857 BIRKHEAD, T.R., and NETTLESHIP, D.N. - 1980
Census methods for murres, *Uria* species: a unified approach; *Env. Can.*, Can. Wildl. Serv. Occasional Paper No. 43, ISSN-0576-6370, 25 p.

Methods are presented for estimating (a) population size and (b) population status of Common Murres (*Uria aalge*) and Thick-billed Murres (*U. lomvia*). Four colony types in which murres breed are described and methods for estimating population size for major colony types are presented. Population status can be determined only through the use of study plots within selected study colonies. Two methods of determining populations status are described. Type I counts provide a precise record of the number of breeding pairs on study plots, but require at least 6 weeks to complete. Type II counts provide a record of mean numbers of individuals on study plots and take only 10 days to complete, but the results are more difficult to interpret than those for type I. The geographic location of study colonies, freqquency of counts and potential sources of error are discussed.

1858 BIRKHEAD, T.R., and NETTLESHIP, D.N. - 1981
Reproductive biology of Thick-billed Murres (*Uria Lomvia*): an inter-colony comparison; *The Auk*, vol. 98, no. 2, pp. 258-269.

Observations of the reproductive biology of Thick-billed Murres were made at Cape Hay, Bylot Island and at Coburg Island, Northwest Territories, Canada simultaneously by two teams between June and September 1979. The median laying date at Coburg (2 July) was 4 days earlier than at Cape Hay (6 July), and this resulted in the following differences in breeding biology. At Coburg egg volumes were larger, chick growth rates higher, and the proportion of chicks fledged per pair higher than at Cape Hay. An additional factor that reduced breeding success at Cape Hay, independent of laying date, was ice- and rockfalls onto incubating birds. At both colonies chicks were fed mainly on arctic cod (*Boreogadus saida*). At Cape Hay 48% of the pairs raised a chick to fledging, with a mean fledging weight of 190.6 g, whereas the corresponding values for Coburg were 71% and 206.1 g.

1859 BROWN, R.G.B., and NETTLESHIP, D.N. - 1981
The biological significance of polynyas to arctic colonial seabirds; *in* Polynyas in the Canadian Arctic, Eds. I. Stirling and H. Cleator, Env. Can., Can. Wildl. Serv. Occasional Paper No. 45, pp. 59-65.

Recurring polynyas, leads, and other open-water areas are important to populations of seabirds wintering in the Canadian Low Arctic: along southeast Baffin Island, and in Hudson Strait and Hudson Bay. Polynyas at high latitudes, north of approximately 70°N, are used by only a small number of wintering birds, mainly Ross' Gulls (*Rhodostethia rosea*) in the Arctic Ocean and Black Guillemots (*Cepphus grylle*) farther south. The bulk of the high arctic seabird population moves to the west Greenland polynya or farther south to winter. However, recurring polynyas are extremely important in both the High and Low Arctic when the birds return in the spring. Open water gives the birds early access to the breeding site; it also allows an earlier zooplankton bloom than in adjacent, ice-covered waters. There is a clear association between the breeding locations of the highly colonial seabird species and the presence of recurring polynyas in both the North American and European Arctics. With one apparent exception (the Black Guillemot colony at Skruis Point, Jones Sound), there are no major seabird colonies in the Canadian Arctic that are not adjacent to recurring polynyas. Where polynyas occur and major colonies are absent these open-water areas are either too small or too distant from the floe edge, or they are adjacent to coasts lacking suitable nesting habitat for cliff-breeding seabirds.

1860 BRUEMMER, F. - 1981
Beluga: die laechelnden Wale; *TIERWELT*, vol. 12. December 1981, pp. 4-9.

1861 DeMASTER, D.P., KINGSLEY, M.C.S., and STIRLING, I. - 1980
A multiple mark and recapture estimate applied to polar bears; *Can. J. Zool.*, vol. 58, no. 4, pp. 633-638.

The mark-recapture technique described in this paper estimates polar bear (*Ursus maritimus*) populations for all sample periods except the first sample period, incorporates an open population model, and is supported by ecological data from ringed seals and polar bears. The estimation procedure requires that survival rates are either known or estimated independently as part of the research program. Reasonably precise estimates will be produced if 10 to 20% of the population can be marked and sample sizes of 150 bears can be handled at any given sample period.

1862 DeMASTER, D.P., and STIRLING, I. - 1981
Ursus maritimus; *MAMMALIAN SPECIES*, no. 145, pp. 1-7, 3 figs.

Order Carnivora, Family Ursidae. The genus *Ursus* includes three species. The living populations of *Ursus maritimus* are not divided into subspecies although one fossil subspecies is recognized.

1863 GASTON, A.J. - 1980
Seabird Investigations in Hudson Strait; *Polar Cont. Shelf Proj.*, internal report, 36 p.

Hudson Strait and adjacent areas of northern Hudson Bay support large populations of seabirds during the summer. By far the most numerous species is the Thick-billed Murre *Uria lomvia* which nests in two large colonies on Akpatok Island, in Ungava Bay, and a third situated on either side of Digges Sound, at the western end of Hudson Strait. About 665,000 pairs of murres nest in these three colonies, constituting 29% of the western Atlantic population (52% of the Canadian population) and practically all migrate to winter off Labrador and Newfoundland, passing southwards during September-November and returning in April-May.

1864 GERACI, J.R., ST. AUBIN, D.J., and
SMITH, T.G. - 1979
Influence of Age, Condition, Sampling Time, and Method on Plasma Chemical Constituents in Free-Ranging Ringed Seals; *Phoca hispida*; *J. Fish. Res. Board Can.*, vol. 36, no. 10, pp. 1278-1282.

Blood samples were obtained from 29 free-ranging ringed seals, *Phoca hispida*, on Herschel Island, Y.T.; 10 were shot and 19 were caught in nets. Age, condition, sampling time, and method had variable influence on plasma chemical constituents. Plasma sodium, chloride, and cholesterol levels in three seals judged to be in poor condition were lower than in the 26 remaining seals. Uric acid was highest in shot pups, but the dynamics of this nitrogenous metabolite in seals are obscure. Plasma levels of alkaline phosphatase, calcium, and cholesterol varied with age. Shot seals had higher plasma triglycerides and blood urea nitrogen (BUN) as a result of recent feeding. For reasons unknown, the circulating levels of two hepatocellular enzymes were elevated in all samples. Plasma from shot seals had falsely elevated potassium levels, due to the sampling technique. Glucose, bilirubin, inorganic phosphate, and aspartate aminotransferase were not significantly influenced by any of the variables studied. The plasma electrolytes and BUN in five captive ringed seals sampled over a 1-yr period correlated with levels in healthy, fasted free-ranging seals; uric acid levels were lower in the captive seals.

1865 GERACI, J.R., and SMITH, T.G. - 1979
Vitamin C in the Diet of Inuit Hunters From Holman, Northwest Territories; *Arctic*, vol. 32, no. 2, pp. 135-139.

During the spring and summer months the diet of three Inuit families living in a seal hunting camp south of Holman, N.W.T., was studied. A total of 13 food items including the most commonly eaten mammal, bird and plant species were analysed for Vitamin C in both the raw and cooked state. We document a daily intake of ascorbic acid of between 11 and 118 mg and estimate a mean dose of at least 30 mg. This is well above the levels documented in larger transitional culture villages by a recent Nutrition Canada report.

1866 GRAY, D.R. - 1979
Movements and Behaviour of Tagged Muskoxen (*Ovibos moschatus*) on Bathurst Island, N.W.T.; *Musk-ox*, vol. 25, pp. 29-46.

During a study of the behaviour of wild muskoxen (*Ovibos moschatus* Zimmermann) on Bathurst Island, N.W.T. from 1968 to 1978, observations were made on the movements and behaviour of ten of the twelve muskoxen marked with ear tags and collars in 1970 and 1971. Of the ten muskoxen resighted after tagging, one bull was seen on ten separate occasions, five were seen either four or five times, and four were seen only once. A single resighting resulted in periods of observation lasting from several minutes to 23 days. Ear tags lasted well and were in place for at least three years but provided limited visibility. Radio collars were only effective for visual identification but at least one individual lost his collar within three years. Observations of individual tagged muskoxen included the following aspects of muskox behaviour; challenging of herd bull by solitary bulls, dominance fighting between bulls, roles of solitary and dominant bulls, maternal relationships, reactions to disturbance by man, and defence against wolves. One bull tagged as a solitary animal was later seen as the dominant bull of a large herd. Other bulls separated from herds were solitary when resighted. Tagged animals were resighted at distances of up to 44 km from the tagging location and moved up to 42 km between consecutive resightings. The presence of tagged animals in herds observed over several weeks confirmed the relative instability of muskox herds.

1867 GRAY, D.R. - 1981
The Muskoxen of Sverdrup Pass; *the arctic circular*, vol. xxx, no. 2, June 1981, pp. 20-23.

Though Sverdrup was the first European to use the pass as a route across Ellesmere Island, he certainly was not the first to use the route, nor the first to hunt muskoxen there. As he recorded in 1899 and as is still clearly evident today, the pass was used extensively by Eskimo peoples. Sverdrup Pass is part of what has been described as "the Muskox Way". Archaeologists believe that this route was one of the primary routes used by early Eskimos moving eastward across the Arctic Islands towards Greenland.

1868 GUNN, A., and MILLER, F.L. - 1980
Responses of Peary Caribou cow-calf pairs to Helicopter Harassment in the Canadian High Arctic; *in* Proc. 2nd Int. Reindeer/Caribou Sym. Eds. E. Reimers, E. Gaare, and S. Skjenneberg, Røros, Norway, 1979, pp. 497-507.

We simulated the slinging of loads by helicopter by flying sets of six passes at 240-370 metres above ground level over groups of Peary caribou on Prince of Wales Island, Northwest Territories. We were especially interested in the responses of cow-calf pairs as we had previously noted their high responsiveness relative to other group types during helicopter harassment. Ground observers continuously recorded the behavior of 20 cow-calf pairs before, during and after sets of 6 passes in July-August, 1977. We obtained 368 responses or activities from cow-calf pairs from each of four phases of the 92 passes. Calves responded to 86.7% of the 91 phases during which cows responded, and calves also responded during 28 phases when their cow was foraging or bedded. Of the 123 locomotary responses 19.5% and 20.3% were attributable to regrouping of the cow-calf pair and the pair rejoining their group, respectively. Only 2.2% of the cow-calf pairs were trotting as the helicopter departed, and within 1-min the pair still in sight had stopped trotting and was foraging. Calves tended to alert more and respond sooner than their maternal cows. The calves were also more likely to rejoin their maternal cows than the cows to seek out their calves.

1869 GUNN, A., MILLER, F.L., and THOMAS, D.C. - 1980-81
The Current Status and Future of Peary Caribou *Rangifer Tarandus Pearyi* on the Arctic Islands of Canada; *Biological Conservation*, vol. 19, pp. 283-296.

The Peary caribou *Rangifer tarandus pearyi* is a unique subspecies confined almost entirely to the Canadian Arctic Archipelago. The decline of the population by 89% on the western Queen Elizabeth Islands between 1961 and 1974 has continued until at least 1977. The decline was principally caused by climatic changes but Peary caribou are potentially under additional pressure from hunting and disturbances associated with increasing industrial activities. We believe there are only 10-15,000 Peary caribou in Canada, and the subspecies was classified as "Threatened" in 1979. The population dynamics of Peary caribou are unique among North American ungulates because weather, especially winter weather, dominates not only the reproductive rate but also recruitment and adult survival. The inter-island movements are a significant adaptation not only to sparse ranges and snow conditions, but also to recolonisation of islands that periodically, through a series of severe winters, lose their caribou.

1870 HAY, K.A. - 1980
Age Determination of the Narwhal, *Monodon monoceros L.*; *Rep. Int. Whal. Commn.*, Special Issue 3, pp. 119-132.

The growth layers which are visible on the polished cut surface of the longitudinally-bisected embedded tooth and in thin transverse sections of the periosteal zone of the anterolabial portion of the mandible of the narwhal are described and found to provide a valid index of age for this species. However, the embedded tooth occludes due to closure of the root by enveloping cementum after the deposition of 10 to 20 dentinal growth layers; mandibular periosteal growth layers must be used to estimate the ages of narwhals with occluded teeth. Up to 50 mandibular periosteal layers are deposited in male narwhals, which have a positive net accumulation of these layers throughout life, in spite of the resorption of several first-formed layers. Female narwhals deposit a maximum of 30 mandibular periosteal layers, suggesting that in older females approaching physical maturity there is no net accumulation of these layers. Dentinal and mandibular layers are equal in number (at least in males) until the time of occlusion of the embedded tooth. The time basis of the layers is not known with certainty. However, on the basis of a statistical analysis of the body length-frequency distribution, it is estimated that about three layers are deposited annually during the first two or three years of life. Comparison of the annual ovulation rate with the accumulation rate of corpora albicantia suggests that one growth layer is deposited annually in mature females.

1871 JONKEL, C.J., STIRLING, I., KOLENOSKY, G., MILLER, S., and ROBERTSON, R. - 1976
Polar Bear Research in Canada, 1972-1974; *in* Proc. 5th Working Meeting of the Polar Bear Specialist Group, Inter. Union Conservation of Nature and Natural Resources (IUCN) Supplementary Paper No. 42, pp. 23-36.

This paper gives a résumé of further work completed or initiated since the 1972 report to IUCN, and an outline of work planned.

1872 LGL ECOLOGICAL RESEARCH ASSOCIATES, Inc. - 1981
Behavior, Disturbance Responses and Feeding of Bowhead Whales in the Beaufort Sea, 1980, Report to Contract AA-851-CTO-44, US Dept. of Interior, ed. W.J. Richardson, 273 p.

The imminence of offshore exploration for oil and gas in the Alaskan part of the Beaufort Sea has raised concerns about the potential for disturbance of bowhead whales. The bowhead, *Balaena mysticetus*, is a baleen whale inhabiting cold northern waters. Historically, five substantial populations existed: western arctic, Davis Strait, Hudson Bay, Okhotsk Sea, and Spitsbergen. The western arctic stock inhabits the Bering, Chukchi and Beaufort Seas off the shores of Alaska, the U.S.S.R., and Canada. All five populations were heavily exploited by commercial whalers, and all are now seriously reduced. Only the western arctic population continues to be of substantial size, yet even it is considered to be rare and endangered under U.S. legislation, in Canada, and by the International Whaling Commission. The 'best estimate' of the size of the western arctic stock is 2264 individuals.

1873 MacDONALD, S.D. - 1981
Scientific Progress: Terrestrial Biology, an Overview; *in* Proc. 23rd Sym., Royal Soc. Can., Yellowknife, N.W.T., 11-13 August 1980, pp. 171-186.

1874 MARTIN, M., and BARRY, T.W. - 1978
Nesting Behavior and Food Habits of Parasitic Jaegers at Anderson River Delta, Northwest Territories; *Can. Field-Naturalist*, vol. 92, no. 1, pp. 45-50.

Based on the seven nests located at Anderson River delta in 1973, Parasitic Jaegers (*Stercorarius parasiticus*) had a breeding density of 1 pair per 2300 ha. Breeding success was 14.3%. Males and females shared incubation. A chick at one nest was unattended by an adult only 8% of the time. Defended core areas were within a 300-m radius of the nest, although hunting areas extended at least 3 km. Bird remains, particularly passerines, were found in 85.0% of the pellets collected. Mammals, mainly microtine rodents, were in 25.4% of the pellets. Other food included eggs, insects, and berries.

1875 MARTIN, S.K. - 1980
Environmental Factors Affecting High Arctic Sea Ice Habitat of Polar Bears; unpub. M.Sc. Thesis, Univ. Montana, 127 p.

Habitat of polar bears (*Ursus maritimus*) on coastal sea ice was investigated through observation of undisturbed polar bears and their environment. Approximately 40 sq km of nearshore sea ice were kept under 24-hour surveillance from 4 field camps established successively from 20 May to 18 July 1979 on island coasts bordering Barrow Strait and Lancaster Sound, Northwest Territories, Canada. Results of recent field work were used to choose 2 areas heavily used by polar bears and 2 lightly used areas for study. Several biological and physical parameters of the coastal sea ice ecosystems were compared between study areas. Data analysis indicated that the observed polar bears exhibited habitat selection on the sea ice. Recorded activities of the bears included travel, play, sleep and several hunting methods. The heavily used study areas harbored higher numbers of seals than the lightly used areas. Bird densities were higher in areas heavily used by bears and plant cover was greater on beaches bordering the sea ice in these areas. Coastal ice areas receiving the greatest polar bear use had the greatest amounts of smooth ice, indicating greater stability. The bay receiving most use by polar bears had more diversity in ice types than the unused bays. Examination of data on habitat selection by polar bears in offshore areas, collected in 1978, indicated that most levels of use of ice types were similar to patterns of use detected in coastal areas.

1876 MAYFIELD, H.F. - 1978
Undependable Breeding Conditions in the Red Phalarope; *The Auk*, vol. 95, no. 3, pp. 590-592.

Unreliable breeding conditions place a premium on female ability to produce additional and replacement clutches, and therefore may foster female emancipation from care of eggs and young, and polyandry. The Red Phalarope (*Phalaropus fulicarius*) presents one of the rare examples of these circumstances among birds.

Red Phalaropes I studied on Bathurst Island in the Canadian high arctic showed wide fluctuations from year to year in breeding population and nesting success as a result of environmental factors. The capricious climate affected the accessibility of nesting sites and food, and arctic foxes (*Alopex lagopus*) brought severe losses to nests in years of fox abundance.

1877 MAYFIELD, H.F. - 1979
Red Phalaropes Breeding on Bathurst Island; *The Living Bird*, 17th Annual, 1978, Cornell Laboratory of Ornithology, pp. 7-39.

The Red Phalarope (*Phalaropus fulicarius*) nests on Arctic Islands and on the northernmost fringe of continental North America and Asia. At other seasons of the year it lives on southern seas, mainly south of the Equator in both hemispheres where ocean currents bring plankton to the surface in abundance. It is the most pelagic of the phalaropes and seldom comes onto land except when nesting. It nests farther north and winters farther south than the closely related Northern Phalarope (*Phalaropus lobatus*), although their ranges overlap. The other member of the family, the Wilson's phalarope (*P. tricolor*), nests in the interior of North America and winters inland in South America.

The three species of phalaropes have attracted attention because of the reversal of usual sex roles. The females are larger, more brightly colored, and more aggressive in courtship, and males provide the incubation of eggs and care of the young. The Red Phalarope has been studied least because of the remoteness of its nesting range. Most observations have been limited to a single season or to incidental notes gathered in the course of other studies. This study offers more detailed information about the Red Phalarope's natural history than previously reported, and will hopefully encourage further study.

1878 McDONALD, E.J., and MARTELL, A.M. - 1981
Twinning and Postpartum Activity in Barren-Ground Caribou (*Rangifer tarandus*); *Can. Field-Naturalist*, vol. 95, no. 3, pp. 354-355.

On 26 May 1980 twin Caribou calves (*Rangifer tarandus*) were observed on the calving grounds of the Porcupine Caribou herd in the northern Yukon Territory. Postpartum activity of one of the twins was delayed relative to that of the other twin and to that of a single calf born at the same time.

1879 McLAREN, P., BARRIE, W.B., SEMPELS, J.M., SIEFFERT, R.A., TAYLOR, R.B., and THOMSON, D. - 1981
Coastal Environmental Data from Eastern Lancaster Sound and Northeastern Baffin Island, NWT; *Bed. Inst. Ocean.*, Data Series Bl-D-81-1, 283 p.

Twelve coastal sites were surveyed during the summers of 1978 and 1979 along eastern Lancaster Sound and northeast Baffin Island, N.W.T. For seven of the sites, marine surveys and diving operations were conducted to obtain geological and biological information of the nearshore zone. Field data from each site are presented in a series of maps which illustrate nearshore bathymetry, bottom sediment characteristics, sea bottom morphology, biomass, abundance of organisms, and species associations. The sedimentological and biological data are also summarized in tables. At all twelve sites, the morphological and sedimentological characteristics of representative beaches were examined and in this report are illustrated using photographs, figures, and tables. Additional information on seasonal thaw depths and storm limits is recorded for some beaches. This report provides a photographic and quantitative coastal data base to which reference can be made in the event of future development or environmental emergencies, e.g. oil spills, along these coasts.

0962 MILLER, F.L., and RUSSELL, R.H. - 1977
Distributions, movements and numbers of Peary caribou and muskoxen on Western Queen Elizabeth Islands, Northwest Territories, 1972-74; *Env. Can.*, Can. Wildl. Serv. Report Series No. 40, 55 p.

1880 MILLER, F.L., and GUNN, A. - 1980
Behavioral Responses of Muskox Herds to Simulation of Cargo Slinging by Helicopter, Northwest Territories; *Can. Field-Naturalist.* vol. 94, no. 1, pp. 52-60.

During a study of helicopter harassment of three different Muskox (*Ovibos moschatus*) herds we flew two sets of overflights with five passes each and one set of six passes in 1976 and 27 sets of overflights with six passes each in 1977 to simulate exposure to cargo slinging operations. The flights were made over two identifiable Muskox herds in 1976 and over three identifiable herds in 1977. We categorized on-going maintenance activity (bedded or foraging) as no response; alerted or walking as a moderate response; and cantering or galloping as an extreme response. In 1977, but not in 1976, there was a trend toward decreasing responsiveness within the series of passes, which indicated short-term habituation by the Muskoxen to the helicopter flying at high altitudes (> 180 m above ground level). There was consistent variation in the levels of responses among the three herds when similarly harassed, that allowed us to characterize one herd as "calm", one "excitable", and one intermediate. Results from repeated simulations of cargo slinging over the three identifiable Muskox herds suggest that Muskoxen in the most "excitable" herd exhibited most long-term habituation. There was no evidence that the exposure of those Muskoxen to the levels of helicopter harassment we used caused any injuries, herd splintering, or range abandonment.

1881 MILLER, F.L., and KILIAAN, H. - 1980
Inter-island movements of Peary caribou in the Prince of Wales Island - Somerset Island - Boothia Peninsula complex, Northwest Territories, May-July 1979; *Env. Can.*, Can. Wildl. Serv. Progress Notes No. 107, January 1980, 7 p.

Locations, directions and origins and destinations of Peary caribou (*Rangifer tarandus pearyi*) trails across the sea-ice of (1) Baring Channel between Mecham and Russell islands and northern Prince of Wales Island, (2) Peel Sound between eastern Prince of Wales Island and western Somerset Island, (3) Franklin Strait between the Boothia Peninsula and southeastern Prince of Wales Island, and Bellot Strait between the northern Boothia Peninsula and southern Somerset Island were obtained during snowmobile treks and helicopter flights from 5 May to 1 July 1979. A total of 103 caribou trails were located on the sea-ice and an additional eight trails were found on the ice of Inner Browne Bay and Young Bay, which indicated that inter-island movements of caribou had taken place. For the first time, west to east inter-island movements by caribou were detected in the spring of 1979 on the sea-ice of Peel Sound between eastern Prince of Wales Island and western Somerset Island, and on the sea-ice of Franklin Strait between the northern Boothia Peninsula and southeastern Prince of Wales Island. Otherwise, the patterns of inter-island movements of Peary caribou in the study area were in agreement with those of 1977 and 1978.

1882 MILLER, F.L., and KILIAAN, H.P.L. - 1980
Some observations on springtime snow/ice conditions on 10 Canadian high arctic islands - and a preliminary comparison of snow/ice conditions between eastern Prince of Wales Island and western Somerset Island, NWT, 5 May - 2 July 1979; *Env. Can.*, Can. Wildl. Serv. Progress Notes No. 116, December 1980, 11 p.

Snow and ice measurements were made between 5 May and 2 July 1979 to gain insight into the timing, duration and extensiveness of springtime accumulations of ground-fast ice and superimposed ice lenses in the snow cover. The study area was on eastern Prince of Wales Island, four of its eastern satellite islands, Somerset Island and four of its western satellite islands. Snowmobiles or a Bell 206B helicopter were used to reach the snow/ice sample sites. Snow/ice measurements were obtained from 1776 sample site holes dug at 92 locations during three periods: premelt, 5 May - 2 June; melt, 8 - 27 June; and run-off, 1 - 2 July. Proportionately more snow-free sites occurred on Prince of Wales Island (65.2%) than on Somerset Island (38.1%) during run-off ($P<0.005$). Average snow depth was significantly greater ($P<0.001$) on Somerset Island than on Prince of Wales (45.2%, 96.4 mm) during run-off. Superimposed ground-fast ice occurred at 36.5% of the sites on Somerset Island and 36.4% of those on Prince of Wales during run-off. Average thickness of ground-fast ice was non-significantly greater on Prince of Wales Island (12.9 %, 7.8 mm) than on Somerset during run-off. Superimposed ice lens in the snow cover occurred at 19.2% of the sites on Somerset Island and at only 6.6% on Prince of Wales during run-off. Average thickness of total ice lens found per site was non-significantly greater on Prince of Wales Island (34.7%, 10.2 mm) than on Somerset. Preliminary comparisons suggest that more snow-free range should be available sooner to Peary caribou on eastern Prince of Wales Island than on western Somerset. However, snow-covered ranges on either island would be iced over and unavailable to Peary caribou at that time of the year. Further data are necessary to allow greater insight into the importance of springtime unavailability of range to Peary caribou, especially lactating cows and newborn calves.

1883 MORRISON, R.I.G. - 1975
Migration and Morphometrics of European Knot and Turnstone on Ellesmere Island, Canada; *Bird-Banding*, vol. 46, no. 4, pp. 290-301.

It was not until 1953 that Godfrey pointed out that the Knots (*Calidris c. canutus*) and Turnstones (*Arenaria i. interpres*) breeding in the Canadian high arctic on Ellesmere Island could be referred on taxonomic grounds to the nominate races wintering in the Old World. Subsequent work has supported this conclusion. However, banding records confirming movements between Ellesmere Island and Europe have been very few to date, involving a single Knot and three Turnstones. The present paper reports eight further records involving movements of these species between Europe and Ellesmere Island, and draws attention to two other recent recoveries on Baffin Island. The yearly cycle and migration patterns are discussed in the light of the banding records and weight levels recorded at Alert and during migration in Iceland. Measurements of birds banded at Alert and of specimens from Eureka are presented to assist in defining racial criteria.

1884 MORRISON, R.I.G. - 1976
Further Records, Including the First Double-journey Recovery, of European-banded Ruddy Turnstones on Ellesmere Island, N.W.T.; *Bird-Banding*, vol. 47, no. 3, pp. 274.

Recoveries and measurements of Knots (*Calidris canutus*) and Ruddy Turnstones (*Arenaria interpres*) banded in Europe and recovered in the Canadian high arctic were recently summarized by Morrison. Two further records of European-banded turnstones were obtained on Ellesmere Island in 1975, and one of these birds has subsequently been recaptured on the wintering grounds in Britain.

1885 MORRISON, R.I.G. - 1977
Migration of Arctic Waders Wintering in Europe; *Polar Record*, vol. 18, no. 116, pp. 475-486.

Waders are among the most characteristic birds breeding in Arctic regions. The group includes species such as the Knot *Calidris canutus* and Turnstone *Arenaria interpres* whose breeding distribution spreads to the most northerly points of land in the world, along the shores of Greenland and Ellesmere Island bordering the Arctic Ocean. To succeed, these species must be highly adapted to their environment, able to fit all the events of the nesting season - territorial procurement, laying, incubation and hatching of eggs, and raising of young - into the short Arctic summer, able to withstand extremes of weather and fluctuations in food supply, and to avoid the attentions of mammalian and avian predators. To exploit their Arctic niche, these birds make long and spectacular migrations from a wintering area where climate and food supply are suitable for subsistence but not for reproduction. Owing to the remoteness of the Arctic breeding areas, details of the migrations of these species have remained obscure or undocumented until relatively recently. This article describes the development of research on wader migration in Britain and the research expeditions which have taken place since 1970 to various Arctic, sub-Arctic (and sub-tropical) areas, and which together have clarified or solved many aspects of the migration of species wintering in Europe. Some of the features of the migration of the Knot are discussed in particular, as a representative species of the group.

1886 NETTLESHIP, D.N., BIRKHEAD, T.R., and GASTON, A.J. - 1979
Reproductive Failure Among Arctic Seabirds Associated with Unusual Ice Conditions in Lancaster Sound 1978; *Env. Can.*, Can. Wildl. Serv. Bed. Inst. Ocean., Report No. 77, 29 p.

A comparison of breeding performance of populations of seabirds in Lancaster Sound and vicinity shows that 1978 was a disaster year. Breeding rates for surface-feeding species (Northern Fulmar, Black-legged Kittiwake, Glaucous Gull) were reduced to 10-20% while pursuit-diving species (Thick-billed Murre, Black Guillemot) which did manage to reproduce close to a normal level did so late and as a consequence suffered a very high pre- and post-fledging mortality. A detailed examination of Thick-billed Murres revealed a three-week delay in egg-laying, the production of smaller eggs and chicks, reduced chick-feeding rates and abnormal parental behaviours. These data represent the first detailed account of the effect of unusually severe ice conditions on reproduction of arctic seabirds.

1887 PRACH, R.W., BOYD, H., and COOCH, F.G. - 1981
Polynyas and seaducks; *in* Polynyas in the Canadian Arctic, eds. I Stirling and Holly Cleator, Env. Can., Can. Wildl. Serv. Occasional Paper No. 45, pp. 67-70.

With the exception of the recurring lead systems in Hudson Bay and Hudson Strait, polynyas are not used extensively by overwintering seaducks in the Canadian Arctic. Some recurring polynyas, especially those in the western and central Arctic, are important as staging areas prior to the breeding season. The Cape Bathurst polynya and associated leads are a particularly critical staging area for birds moving eastwards into the central Arctic and southeastwards through Dolphin and Union Strait into Queen Maud Gulf. Oil pollution in recurring polynyas, particularly in the Beaufort Sea during spring staging, could greatly reduce arctic seaduck populations.

1888 REED, A., DUPUIS, P., FISCHER, K., and MOSER, J. - 1980
An aerial survey of breeding geese and other wildlife in Foxe Basin and northern Baffin Island, Northwest Territories, July 1979; *Env. Can.*, Can. Wildl. Serv. Progress Notes No. 114, August 1980, 21 p.

An aerial survey of geese was conducted along the shores of Foxe Basin and over northern Baffin Island, NWT, on 7-9 July 1979. Important colonies of Atlantic Brant (*Branta bernicla hrota*) were observed on the east and north shores of the basin (Cape Dominion and Baird Peninsula), as well as on Prince Charles, Air Force and North Spicer islands. The colony on North Spicer had not been previously reported. Snow Geese (*Anser caerulescens*) were recorded throughout the area. The smaller form (*A.c. caerulescens*) was particularly abundant as a breeding bird along the east shore of the basin (Bowman Bay-Great Plain of the Koukdjuak) while the Baird Peninsula was used by moulting (non-breeding) individuals. The larger form (*A.c. atlanticus*) occupied several large breeding colonies on Bylot Island and near the base of Admiralty Inlet on northern Baffin Island; smaller numbers were recorded further to the west and to the south in Foxe Basin, overlapping somewhat with the range of *A.c. caerulescens*. Canada Geese were less abundant than brant and Snow Geese but were most numerous along the eastern and western shorelines of the basin. Records of other birds and mammals observed during the survey are also presented.

1889 REED, A., and DUPUIS, P. - 1980
A Preliminary Report on Greater Snow Goose and Atlantic Brant Investigations Near Foxe Basin and Northern Baffin Island, NWT, August 1980; *Polar Cont. Shelf Proj.*, internal report, 25 p.

This report deals with the results of field investigations conducted during the summer of 1980 near Foxe Basin and Northern Baffin Island, NWT, in conjunction with a 3-year arctic goose research project.

1890 RING, R.A., and TESAR, D. - 1980
Cold-hardness of the Arctic Beetle, *Pytho Americanus* Kirby Coleoptera, Pythidae (Salpingidae); *J. Insect Physiol.*, vol. 26, pp. 763-774

The arctic beetle, *Pytho americanus* Kirby, is frost tolerant in both larval and adult stages. This is the first demonstration that an insect can tolerate freezing in more than one life stage, a situation which would be congruous with its northern distribution and allow it to spread its life cycle over a number of growing seasons. The main biochemical correlates during the cold hardening process of low temperature acclimation are increasing glycerol and decreasing glycogen concentrations. Glycerol is the only polyol to be synthesized during acclimation, and it accumulates to a maximum of 8.2 and 12.2% of the fresh body weight in larvae and adults respectively. This coincides with the peak of frost tolerance. In addition to its normally assumed roles in cryoprotection it is suggested that glycerol may further serve to minimize dehydration in the overwintering insect by increasing the level of "bound" water. Evidence is presented that indicates that glycerol is synthesized mainly from carbohydrate reserves, especially glycogen, but it does not rule out the possibility that a proportion of free glycerol comes from glyceride sources.

P. americanus larvae and adults have low supercooling potential and maintain their supercooling points in the region of -4° to -8°C. It is hypothesized that these elevated supercooling points are a result of the presence in the haemolymph of nucleating agents which ensure ice formation at high sub-zero temperatures. It is believed that this beetle overwinters in a frozen state within its microhabitat, which is under bark of fallen spruce which is, in turn, covered by an insulating blanket of snow. The advantages of this overwintering strategy are discussed.

1891 RING, R.A. - 1980
Insects and their Cells; *in* Low Temperature Preservation in Medicine and Biology (1980), eds. M.J. Ashwood-Smith and J. Farrant, Pitman Medical Ltd., Kent, England, pp. 187-307.

An attempt will be made to appraise the current status of low temperature preservation in the field of entomology and make some comparisons with similar situations in other biological systems. An attempt will be made to emphasize the practical aspects of the subject and to standardise some of the terminology that has been used in the past, often in a confusing way.

1892 RING, R.A., and TESAR, D. - 1981
Adaptations to Cold in Canadian Arctic Insects; *Cryobiology*. vol. 18, pp. 199-211.

Canada is ideally located for studies on insect cold hardiness. The insect fauna of Canada has been estimated at just under 30,000 species with almost the same number again either undescribed or unreported. Its arctic insect fauna is rich and varied, estimated to be in the region of 1626 identified species. If an "arctic insect" is defined as any species occurring at or beyond the northern limits of the tree line, a satisfactory definition for the entomologist since trees affect the distribution, habitat and behavior of insects in so many ways (2), this means that a region occupying over 25% of the area of the country supports approximately 5% of its insect species.

1893 ROWELL, J. - 1980
A preliminary study of the reproductive anatomy of the female muskox (*Ovibos moschatus*); unpub. M.Sc. Thesis, Univ. Ottawa, 190 p.

Various aspects of the reproductive anatomy of 23 wild female muskoxen were documented and compared with similar structures in cattle, sheep and goats. In general, the reproductive tract of the non-pregnant muskox resembled that of sheep and goats, although species as well as individual variations were found in the gross anatomy of the cervix.

The placenta and the arrangement of fetal membranes during late pregnancy were typical of Artiodactyla, being considered morphologically closer to those of sheep and goats than cattle. Endometrial hyperplastic cysts were found in all eight pregnant tracts but were not considered pathological.

Endometrial pigmentation, found in all parous non-pregnant tracts were believed to be hematogenous as opposed to melanoblastic in origin.

The information on the ovaries was incomplete though these data support the assumption that the muskox is seasonally polyestrous and monovular. Follicular development and early corpus luteum formation appeared similar to these processes in domestic animals. Conversely, the ovaries of eight tracts collected during late pregnancy showed no morphological evidence of the corpus luteum, a condition not found among the domestic species. Histologically the corpus luteum of late pregnancy appeared to be highly regressed and non-functional. One pregnant specimen had two corpora lutea and it has been suggested that one of these may represent an accessory corpus luteum.

A unique aspect of the muskox uterus was a prominent muscular band, found on the antimesometrial border, which was associated with parity. It has been suggested that a large lymphatic pathway developed in this region during pregnancy though the function of the pathway is not clear.

1894 SILVERMAN, H.B. - 1979
Social Organization and Behaviour of the Narwhal, *Monodon Monoceros* L. in Lancaster Sound, Pond Inlet, and Tremblay Sound, Northwest Territories; unpub. M.Sc. Thesis, McGill Univ. 147 p.

Narwhals (*Monodon monoceros* L.) migrate through Lancaster Sound in June and July. They feed intensively in the ice covered waters of Pond Inlet. Ice conditions seem to influence indirectly narwhal distribution and group size by affecting the distribution of their prey. Narwhals travel together in small scattered groups ($\bar{x}$ = 3.8 individuals per group) and show sex and age class segregation. Complex individual and social behaviour was most common in Tremblay Sound during the ice free season when feeding activity had decreased. These behaviour patterns are probably components of mating and rutting behaviour sequences and may assist juveniles in the development of skills for adult sexual roles. Rapid increases in tusk size and number of scars on the heads of males, at sexual maturity, indicate that the tusk is used in overt aggressive interactions between adult males, but no such encounters were seen. Intermale competition is probably most intense during the mating season (March to May).

1895 SMITH, T.G. - 1973
Population Dynamics of the Ringed Seal in the Canadian Eastern Arctic; *Fish. Res. Bd. Can.*, bulletin no. 181, 55 p.

In a study of the population dynamics of the ringed seal (*Phoca hispida*) in Home Bay and Cumberland Sound, N.W.T., 10,856 seals were aged and 1145 reproductive tracts examined. Tooth structure was carefully examined and the criteria used in ageing were described in detail.

The nose-tail length and estimated weight of adult males were significantly greater than for females and greater in adult seals from Home Bay than in seals shot in Cumberland Sound.

Males mature sexually at age 7 and 40% of 4-year-old females are mature. There is an 81-day delayed implantation period and an active gestation of 270 days.

Subadult seals generally disperse offshore in winter and breeding adults remain in the fast ice. Age differences in stock composition from the two areas indicate that Cumberland Sound is low in productivity and receives its seals from adjacent unexploited populations.

Peak haul-out is near the end of June with the seals spending more time on the ice as the season progresses. An estimated 50% of the seals are hidden from view at the peak of diurnal haul-out.

From a low-level aerial survey covering 1192 nautical square miles of ice, 7020 seals were counted. Densities of 8.83, 6.53, and 5.02 seals per nautical square mile were obtained for three categories of fast ice. Corrected total population estimates for Home Bay, Hoare Bay, and Cumberland Sound were 70,684, 36,376, and 58,782.

The sex ratio of the pups and adults from the catches was always 1:1. Age-specific data on reproductive rates from the large Home Bay 1967 sample were used to calculate the vital statistics of the ringed seal populations.

Best estimates of age-specific survival were derived from a number of different analyses and applied to a computer population projection model based on the discrete deterministic matrix approach to population analysis. The exploited population of Home Bay with an assumed rate of increase at stability (r_s) of 0 had the following birth rates: exponential birth rate, $b = 0.1883$; finite birth rate, $e^h = 1.2077$; crude birth rate $B = 0.2077$. The death rates were: exponential death rate, $d = 0.1887$; finite death rate, $e^{-d} = 0.8280$; crude death rate, $D = 0.1719$. The rates for a hypothetical unexploited population (natural mortality only) with an exponential rate of increase at stability (r_s) of 0.1104 were found to be: $b = 0.1979$, $e^h = 1.2188$, $B = 0.2188$, $d = 0.0874$, $e^{-d} = 0.9162$, and $D = 0.0837$. Various aspects of the effect of different survivorship and fertility regimes on the model were investigated.

The best estimate for maximum sustainable yield was 7.2% of the resident stock. The Cumberland Sound population is being overexploited, 15.78% of the estimated resident population being harvested annually. This, however, is offset by the adjacent unexploited areas, which probably contribute a minimum of 4110 seals to its catch annually.

1896 SMITH, T.G. - 1978
Travelling the Arctic by snowmobile; *Can. Geographical J.*, February/March 1978, pp. 60-65.

1897 SMITH, T.G., SLENO, G.A., and TAYLOR, D. - 1979
An aerial survey of marine mammals in the region north of Cornwallis Island, N.W.T.; *Fish. Mar. Serv.*, Tech. Report No. 837, 14 p.

An aerial survey was flown on 16, 17 and 18 July covering the region north of Cornwallis Island, west to Ellef Ringnes Island, north to Meighen Island and east to Ellesmere Island. An overall density of 0.29 ringed seals per km² was observed with a noticeable decrease in the northern sectors. This is less than half the density (0.61 to 0.68 per km²) seen in previous studies to the south in Barrow Strait. There were no strong indications that the peak of haul-out occurs later in more northerly latitudes; neither was there any evidence of seals moving into the area from ice to the south. Both bearded seals and walrus were seen in association with polynyas formed in Hell Gate (76°39'N, 89°45'W) and Penny Strait (76°41'N, 97°30'W). A total of 15 polar bears were sighted on the ice during the survey.

1898 SMITH, T.G., HAY, K., TAYLOR, D., and GREENDALE, R. - 1979
Ringed Seal Breeding Habitat in Viscount Melville Sound, Barrow Strait and Peel Sound; *Fisheries and Env. Can.*, Arctic Bio. Station report to AIPP, INA Pub. No. QS-8160-022-EE-A1, ESCOM Report No. A1-22, 85 p.

Two breeding habitat surveys in 1975 and 1976 revealed the same pattern of birth lair densities. The highest number of birth lairs were found in Barrow Strait east of Lowther Island, in Aston Bay on Northwest Somerset Island and at the head of Peel Sound. Aerial surveys showed comparable seal distributions during the haul-out period. Population estimates based on the birth lair estimates indicate that gross underestimation of population size are possible when based on aerial counts of hauled-out seals. Biological samples taken in the area show a healthy adult population occupying the area during the winter months. Certain areas of high seal density that are also traditional hunting areas for the Inuit of Resolute are identified, and it is recommended that they be left undisturbed.

1899 SMITH, T.G. - 1980
Danger Polar Bear! *Energy, Mines & Resources* and *Fisheries & Oceans*, Cat. M78-6-1980E, ISNB 0-662-10877-9, Info Booklet, 16 p.

The purpose of this booklet is to provide detailed instructions on how to avoid contact with bears and how to behave if confronted. Most of the common situations that will be encountered by either permanent camps or small mobile parties are covered. Polar bears are unpredictable and a real danger. The best strategy is to avoid accidental contact and to prevent attracting them. If you must live and travel in their hunting habitat, use common sense and be prepared.

1900 SMITH, T.G. - 1980
Attention aux ours blancs! *Energie, Mines et Ressources Can.* et *Pêches et Oceans*, Cat. M78-6-1980F, ISNB 0-662-10877-9, 16 p.

La présente brochure a pour but de fournir des conseils détaillés sur la façon d'éviter les ours blancs et sur le comportement à adopter en cas de rencontre. Elle embrasse la majorité des situations ordinaires auxquelles devront faire face les équipes des camps permanents ou des camps mobiles. Les ours blancs ont un comportement imprévisible, et ils constituent un danger réel. La meilleure stratégie est encore de les éviter et de ne rien faire qui puisse les attirer. Dans les cas où il est inévitable de vivre et de se déplacer sur leur territoire de chasse, il faut faire preuve de bon sens et demeurer sur le quivivre.

1901 SMITH, T.G., and HAMMILL, M.O. - 1980
Distribution and food habits of the birds along the southeastern Baffin Island coast; *Fish. & Oceans*, Can. MS Rep. Fish. Aquat. Sci., No. 1573, 23 p.

In coastal areas along the Hall and Beekman Peninsulas, N.W.T., 1125 hours of observations were made from fixed observation points, during walks inland and from small boats in the periods March through October 1978 and 1979. Thirty-five species were identified. A tentative record of a vagrant *Falco sparverius* and definite confirmation of the presence of *Buteo lagopus* are made. The Canada Goose present in the area appears to be *Branta canadensis in-*

terior. One hundred forty-six stomach and crop contents of 15 species of birds were examined. Dominant food items for pelagic feeding birds such as Northern Fulmars *Fulmarus glacialis* and Black-legged Kittiwakes *Rissa tridactyla* were the pteropod *Spiratella helicina* and the squid *Gonatus fabricii.* The most common alcid *Cepphus grylle*, appears to feed mainly on pelagic fish larvae. The two most common ducks in the area, *Somateria mollissima* and *Somateria spectabilis*, exploited the nearshore benthic concentrations of Sea Urchins, *Strongylocentrotus droebachiensis*.

1902 SMITH, T.G., and HAMMILL, M.O. - 1980
Ecology of the ringed seal, *Phoca hispida*, in its fast ice breeding habitat; *Can. J. Zool.*, vol. 59, no. 6, pp. 966-981.

Studies of the behavioral ecology of seals hauled out on the sea ice at Popham Bay, southeastern Baffin Island were conducted from 8 May to 6 June 1978 and 1 May to 20 June 1979. Similar densities and seasonal changes in numbers of hauled out seals were seen in both years. Seal numbers were positively correlated with date and negatively correlated with wind speed. While lying on the ice seals were vigilant and aggressive towards other seals, and females suckled their pups. Individuals were recognized by their different pelage marks. Both males and females showed site tenacity. One male, seen in 1978, was resighted in the study area in 1979. Our observations indicate that ringed seals are territorial and similar to the polygynous Weddell seal of the antarctic in their social organization. Population regulation appears to be affected by availability of suitable fast ice in which to maintain feeding and breeding habitat, with some adjustment of annual recruitment possibly in response to depleted food resources.

1903 SMITH, T.G. - 1980
Hunting, kill and utilization of a caribou by a single gray wolf; *Can. Field-Naturalist*, vol. 94, no. 2, pp. 175-177.

A single wolf was seen killing a Caribou on the sea ice of a small bay on southeastern Baffin Island. The carcass of an assumed weight of 42 kg was totally consumed in approximately 46 h. Crude extrapolations are made indicating that one wolf might kill 28 or more Caribou per year to sustain itself.

1904 SMITH, T.G. - 1980
Polar bear predation of ringed and bearded seals in the land-fast sea ice habitat; *Can. J. Zool.*, vol. 58, no. 12, pp. 2201-2209.

Predation of seals by the polar bear, *Ursus maritimus*, was not significant in the Western Arctic. In the High Central and Eastern Arctic, and along southeastern Baffin Island, bear predation of the subnivean lairs of ringed seals, *Phoca hispida*, was common. The ice types hunted by bears differed between the High Arctic and southeastern Baffin Island. However, no difference was seen in the proportion of successful kills. There is strong evidence that the bearded seal, *Erignathus barbatus*, is an important prey species of the polar bear in southeastern Baffin Island. Polar bears mainly kill newborn pups in their birth lairs. The prime breeding habitat of ringed seals located in ice hummock areas is less successfully preyed upon by bears than other ice types. Several factors such as the complexity of birth lairs and possible olfactory confusion might account for this. Seals under 2 years of age are those most frequently killed by bears. Data are presented to show that harvesting these age-classes provides the maximum return of energy to the bear and results in the least harm to the prey population.

1905 SMITH, T.G., and HAMMILL, M.O. - 1980
Ringed seal, *Phoca hispida*, breeding habitat survey of Bridport Inlet and adjacent coastal ice; *Fish. & Oceans*, Can. MS Rep. Fish. Aquat. Sci., No. 1577, 31 p.

A survey of the breeding habitat of ringed seals, *Phoca hispida*, was conducted at Bridport Inlet and along the adjacent coastline. Lair densities in the inlet itself were very low mainly because of the abundance of multi-year ice and lack of snow cover. Birth lair densities in the whole study area were only 15 percent of those seen in areas of Parry Channel further to the east. All birth lairs and most other lairs were found in two pressure ridges running west from the northern tip of Dealy Island. Birth lair densities along these ridges were slightly higher than on ridges in other arctic localities, recognized to be very productive habitats. This indicates that ridges are very important structures in this area because they are the only features accumulating snow to depths sufficient for lairs to be formed. Polar bear predation attempts were lower than in more easterly sectors of Parry Channel. However, they were frequent enough to indicate that this is an important feeding area. Fox signs on the sea ice indicate that there are more foxes in Viscount Melville Sound than in Barrow Strait or Lancaster Sound. No estimate of predation rates are available yet.

1906 SMITH, T.G., and HAMMILL, M.O. - 1980
A survey of the breeding habitat of ringed seals and a study of their behavior during the spring haul-out period in southeastern Baffin Island; *Fish. & Oceans*, Can. MS Rep. Fish. Aquat. Sci., No. 1561, 47 p.

A survey of the breeding habitat of ringed seals *Phoca hispida* in the fast ice was carried out between Loks Land and northern Brevoort Island on the southeastern Baffin Island coast. Maximum densities of birth lairs were found in the hummocky ice of Cyrus Field Bay and in one small bay on the south coast of Brevoort Island. Polar bear predation at birth lairs was found to be a significant mortality factor for ringed seals. Most of the seals killed were pups born between mid March and mid April. Rain and a thaw in early April melted the subnivean birth lairs, causing the pups to be exposed, and resulted in some mortality both by exposure and increased predation. Wind and low temperatures, expressed as wind chill, were significantly negatively correlated with numbers of seals hauled out on the ice in May. Peak diel densities were seen from 09:00 to 18:00. The sex ratio in the study area showed a predominance of female ringed seals. Seals orient with their heads pointed in the direction of the prevailing wind, which could be an adaptation for examining the area for polar bears. Aggressive behavior occurred between a mother and a weaned pup, and between a presumed mother seal and an adult seal lying near her pup. Seals use olfaction, sight and hearing to examine their surroundings for potential threats. They appear to become habituated to their surroundings and to various disturbances, including the sight of observers moving on the land. A hole-to-seal ratio of 6:1 (48:8) was calculated for part of the study area. However a utilized hole-to-seal ratio was calculated as 2.5:1. An independent calculation involving identified seals showed that they utilized 2.09 haul-out positions on the average. One ringed seal identified in 1978 was resighted in 1979, the first known record of site fidelity in this species.

1907 SMITH, T.G., SINIFF, D.B., REICHLE, R., and STONE, S. - 1981
Coordinated behavior of killer whales, *Orcinus orca*, hunting a crabeater seal, *Lobodon carcinophagus*; *Can. J. Zool.*, vol. 59, no. 6, pp. 1185-1189.

A pod of seven killer whales (*Orcinus orca*) was seen to attack a lone crabeater seal (*Lobodon carcinophagus*) which was lying on an ice floe. The whale located the seal, moved away from the floating ice, then swam as a group close to the floe. This caused a wave which tipped up the ice floe and broke over it, causing the seal to be thrown into the water. The whales swam immediately to the vicinity of where the seal disappeared but it was not possible to ascertain if a kill was made.

1908 STIRLING, I. - 1978
A review of population ecology studies of polar bears conducted in the Western Canadian Arctic from 1971 through 1977; For the Purpose of Evaluating Management Practises; *Can. Wildl. Serv.*, internal report to NWT Wildl. Serv., 68 p.

This report reviews population ecology of polar bears (*Ursus maritimus*) in the Western Canadian Arctic conducted from 1971 to 1977, for the purpose of evaluating management practises and polar bear quotas in that area.

Between October 1970 and May 1977, 528 polar bears were individually tagged. Evaluations of seasonal movements, delineation of the subpopulation, and population estimates were calculated from recoveries of tags from recaptured polar bears or from those shot by Inuit hunters. Specimens for age determination were collected from polar bears killed by Inuit hunters to ascertain the age structure of the hunted population and to evaluate how the pattern of harvesting bears affected the total population. Regrettably these collections were not as complete as might have been desired.

For management purposes, the Western Arctic area can be considered a relatively discrete subpopulation. There was little recorded exchange between bears tagged in the more northern and western portions of the study area. Few of the bears tagged near the edges of the study area moved far enough into the center of the area where they might be included in the Inuit harvest. There are also unknown numbers of unharvested bears north of 75°N and north of the western mainland coast which have part of the study area in their home range but do not come into regular contact with Inuit hunters. Exchange of polar bears between the Alaskan and Western Arctic populations was estimated to be in the order of five to ten percent. Within the population there is a partial segregation into two components, associated with the west coast of Banks Island and the western mainland coast respectively. This appears to be related to the seasonal movements of the bears and the pattern of freeze-up and break-up in the eastern Beaufort Sea.

1909 STIRLING, I. - 1978
A Review of Population Ecology Studies of Polar Bears Conducted in the High Arctic in Polar Bear Management Zone F for the Purpose of Evaluating Management Practises; *Can. Wildl. Serv.* internal report to NWT Fish and Wildl. Serv., 25 p.

This report reviews population ecology studies of the polar bear (*Ursus maritimus*) in the high arctic in Polar Bear Management Zone F, conducted between 1970 and 1977, for the purpose of evaluating management practises and polar bear quotas in that area.

Several reports have already summarized different aspects of the studies of polar bears done in Zone F. Therefore only material relevant to this review has been included and discussed.

For management purposes at least, the polar bear population of Zone F can be considered to be discrete from Zone E. However, even within Zone F, it appears that few bears from the Barrow Strait area are taken by hunters from Pond Inlet or Arctic Bay. Therefore, this review considers mainly those areas hunted by Inuit from Resolute, Grise Fiord and, to a lesser degree, Arctic Bay. A more complete review of the quotas for Inuit from Arctic Bay and Pond Inlet will have to wait for completion of studies in those areas by the Northwest Territories Fish and Wildlife Service.

The mortality rates of males and females were 16.2% and 12.1% respectively. Age-specific natality rates for adult bears ranged between 0.376 and 0.644. The polar bear population in the western portion of Zone F was estimated to be at least in the order of 1700. From calculations of productivity, in relation to mortality rates, it appeared that the quota could safely be increased by 20 bears. Several conditions are recommended should the increase be implemented.

1910 STIRLING, I., DeMASTER, D., ANDRIASHEK, D., and CALVERT, W. - 1979
Report to DINA on the 1978 Survey of the Distribution and Abundance of seals in the eastern Beaufort Sea; unpub. typed report, 20 pp.

Between 1974 and 1975 in the eastern Beaufort Sea, there was a 48.4% decline in the numbers of ringed seals (*Phoca hispida*) counted on identical aerial surveys and 56.6% decline in the numbers of bearded seals (*Erignathus barbatus*). During the same period, there was a 90% decrease in the number of pups born in prime ringed seal breeding habitat. As a direct consequence, there was also a marked decline in both the numbers and natality of polar bears (*Ursus maritimus*). This is the first time in the arctic that we have had good enough data to be able to quantitatively document such changes, albeit that the cause was not clear. Documentation of the natural rate of recovery is vital to future environmental impact assessments because it should give an estimate of the minimum time required for a population to recover from the detrimental effects of large-scale man-made ecological damage.

1911 STIRLING, I., KILIAAN, H.P.L., CALVERT, W., and ANDRIASHEK, D. - 1979
Population ecology studies of polar bears in the area of southeastern and southern Baffin Island and northern Labrador; Progress Report to CWS, Esso Resources Ltd., and NWT Wildl. Br., 88 p.

This report summarizes baseline data available to date on the population ecology of polar bears in southeastern and southern Baffin Island and northern Labrador, and gives some interim conclusions.

1912 STIRLING, I., WALLACE, R.R., and GLAZIER, G.T. - 1979
An environmental research and management strategy for the Eastern Arctic region: a discussion; *Northern Perspectives*, vol. VII, no. 6, pp. 4-5 and 8-9.

1913 STIRLING, I. - 1980
Aspects of the influence of habitats on marine mammals; *in* Int. Sym. on Habitats and their influences on wildlife, Univ. Pretoria, South Africa, July 3-4, 1980, 10 p.

Over the course of evolutionary time, marine mammals have evolved to fill specific neches in marine ecosystems from the tropics to the poles. As environmental changes have occurred, species have had to change as well or go extinct. In an evolutionary sense, the marine mammals can adapt or change in response to various pressures probably varies with the amount of time available and extent of the niche specificity that has evolved. However, the kind of change we are most concerned with here, from a conservation or management point of view, is change of habitat over periods of years or decades, or at most centuries; in other words, rates and types of change that exceed the ability of species to evolve in response.

1914 STIRLING, I., CALVERT, W., and ANDRIASHEK, D. - 1980
Population ecology studies of the polar bear in the area of southeastern Baffin Island; *Can. Wildl. Serv.* Occasional Paper No. 44, 33 p.

During 1974-79, 231 polar bears were captured and tagged in the area of southeastern Baffin Island. Subsequently, 41 recaptures were made of 36 bears. An additional 13 tagged bears were reported killed by Inuk hunters. In general, densities of polar bears and their tracks sighted for each 100 km of sea ice habitat were higher than had been recorded in other areas of the Arctic. However, that appeared to reflect a lesser amount of preferred habitat rather than a greater number of bears. Polar bears in the study area travel onto the land much more during late winter and early spring than they do in other areas of the Arctic.

Polar bears along the southeastern coast of Baffin Island show a high degree of fidelity to their winter and spring feeding areas. In only 23% (8/35) of the independent movements recorded did bears move between the two main population centres on the Cumberland and Hall peninsulas. The data suggested that, within the study area, some bears moved south with the ice during winter and then north in spring. The extent to which polar bears within the study area utilize the offshore pack ice remains unknown.

The most important maternity denning areas, in descending order of importance, were around the seaward tips of the Cumberland, Hall, and Meta Incognita peninsulas. The mean litter size recorded during this study was 1.82 ± 0.079 and most females mated for the first time at four years of age. The mean breeding interval, calculated from six females with known minimum intervals between litters, was 3.5 years.

Sex-specific mortality rates calculated from samples over several different ranges of ages were in excess of 20%. These may be too high because of unknown biases in the data but they are still greater than the 12-14% range calculated from polar bear populations in the Western, Central, and High Arctic areas.

Based on mark and recapture data, the population of polar bears in the study area was estimated to be 700-900. The estimates of population size and age-specific reproductive parameters indicate that 75-90 cubs are born each spring.

1915 STIRLING, I., and KILIAAN, H.P.L. - 1980
Population ecology studies of the polar bear in northern Labrador; *Can. Wildl. Serv.* Occasional Paper No. 42, 19 p.

During spring 1976-79 we marked and recaptured polar bears in northern Labrador. Thirty-seven polar bears were captured and individually tagged. Most were found along the interface between the coastal landfast ice and the drifting pack ice, especially around the mouths of bays. The mark and recapture data indicated a low population (60-90 bears) in the area. Fifty to 80% fewer polar bears and tracks were seen per 100 km of potential habitat surveyed than recorded for other areas of the Arctic. This also indicates a smaller population.

At least some of the polar bears present on the Labrador coast in the spring travel great distances at other times of the year. Journeys were recorded between northern Labrador and both southeastern Baffin Island and northern Hudson Bay. These movements may be seasonal in nature and influenced by sea currents which carry the pack ice on which polar bears sometimes hunt. The number of polar bears that spend the whole year in northern Labrador is unknown.

No evidence of maternity denning was found and the reproductive rates of females captured in northern Labrador were lower than in other areas of the Arctic.

The polar bears in northern Labrador are on the southern edge of their range. Consequently, small environmental changes may have a greater effect on the distribution, numbers, and reproductive parameters there than in other areas of the Arctic. The polar bears found in Labrador are part of a population that is shared with and harvested by Inuit from both the NWT and Quebec. In addition, offshore drilling, with its attendant potential for environmental damage, is now taking place and more activity is projected in Davis Strait and the Labrador Sea. Evolving management practices will have to accommodate all these factors.

1916 STIRLING, I., KINGSLEY, M.C.S., and CALVERT, W. - 1981
The distribution and abundance of seals in the High Arctic, 1980; *Can. Wildl. Serv.* Report to Dome Petroleum, the Arctic Islands Offshore Production Committee and DIAND, 51 p.

The distribution and abundance of the ringed seal *(Phoca hispida)*, the bearded seal *(Erignathus barbatus)* and the walrus *(Odobenus rosmarus)* in the Central Canadian Arctic archipelago were studied by an aerial strip transect sample survey. Seals hauled out on sea ice were counted from 500 ft. between 21 June and 8 July 1980.

Ringed seals were found to be most abundant (0.73 - 0.83/km^2) in Wellington Channel, Barrow Strait and northern Amundsen Gulf, and of moderate abundance (0.36 - 0.48/km^2) in eastern Viscount Melville Sound. They were found to prefer a high cover of ice, and to be especially numerous on ice just starting to break up. One-year-old ice was preferred, and the extensive areas of old ice in western Viscount Melville Sound, Prince Philip Basin and Maclean Strait had low densities. Rotten ice and floe ice were apparently not favoured by ringed seals. The few bearded seals that were counted were mostly near the Penny Strait polynya. One group of walruses was seen, also in this area.

1917 STIRLING, I. - 1981
Polynyas in the Canadian Arctic - Introduction; eds. I. Stirling and H. Cleator, *Can. Wildl. Serv.* Occasional Paper No. 45, 73 p.

The association between marine mammals and birds and the occurrence of open water, including leads, has been reported upon consistently since the first explorers entered the Arctic and later, the Antarctic. More specifically, concentrations of birds and mammals along the interface of the ice edge and the open water have also been noted often. Beyond these rather anecdotal comments, however, few quantitative data have been collected. Consequently, little progress has been made toward gaining an understanding of the ecological significance of polynyas to individual species.

In the Canadian Arctic, the distribution of recurring polynyas is quite localized and their combined areas account for a relatively small proportion of the total arctic marine habitat. Nonetheless, the influence of polynyas and shoreleads on the survival of viable populations of marine birds and mammals appears to be profound. Despite their obvious biological importance, most polynya areas are threatened with extensive disturbance and possible pollution as a result of proposed offshore petrochemical exploration and year-round shipping. In several areas, more than one type of project may be undertaken simultaneously. Unfortunately, at the present time, we cannot adequately evaluate the effects of such disruptions. We simply have not conducted enough baseline research to have a quantitative understanding of the ecological processes that may be unique to polynya areas.

1918 STIRLING, I., CLEATOR, H., and SMITH, T.G. - 1981
Marine mammals; *in* Polynyas in the Canadian Arctic, eds. I. Stirling and H. Cleator, Can. Wildl. Serv. Occasional Paper No. 45, pp. 44-58.

Polynyas appear to play a critical role in the survival of many viable populations of marine mammals in the Canadian Arctic. The role of each area, and the extent to which it may be used, can vary greatly between species, seasons, and individual polynyas. This paper reviews the use of major polynya areas in the Canadian Arctic by each species. Important, and possibly critical, aspects have been identified. Most polynya areas are threatened with extensive disturbance and possible pollution as a result of offshore petrochemical exploration and year-round shipping activities. However, we cannot evaluate the effects of such disruptions because we have an inadequate understanding of the ecological significance of these areas to marine mammals. Considerable research is needed to ensure that the necessary data are available upon which decisions relating to the conservation of marine mammals in polynya areas can be based.

1919 SUTCLIFFE, A.J. - 1980
Polar bears around the camp; *Chrysalis*, The Natural History Museum Staff House J., January 1980, p. 6.

What precautions must people in the Arctic take and what sort of experiences do they have when visited by bears?

1920 THOMAS, D.C., and KROEGER, P. - 1980
In Vitro Digestibilities of Plants in Rumen Fluids of Peary Caribou; *Arctic*, vol. 33, no. 4, pp. 757-767.

In vitro fermentation with expressed rumen fluids was used to evaluate the apparent comparative digestibilities of plants ingested by Peary caribou (*Rangifer tarandus pearyi*) in arctic Canada. The apparent digestibilities of vascular plant components collected in summer and fermented for 60 hours with "summer" rumen inoculum generally were in the range 50-80%, digestibilities of lichens ranged from 18-85%, and those of mosses from 11-35%. In similar trials in which plants collected in the winter were fermented for 60 hours with "winter" rumen inoculum, the green parts of two sedge species were more digestible (65 and 74%) than the corresponding cured leaves (25 and 43%), lichens generally were highly digestible (54-83%) and mosses poorly digested (3-11%). We obtained clear evidence of a seasonal change in the digestive capacity of rumen fluids. Fermentation for periods of 30, 60, and 90 hours revealed that components of vascular plants were digested most rapidly, followed by lichens and mosses. There was no interaction among mixed samples of plants; composite digestibilities approximated expected values based on weighted mean digestibilities of the component species. Peary caribou select forages of high digestibility but they consume, perhaps incidentally, plants of low digestibility when snow or ice restricts their access to the highly digestible species.

1921 THOMAS, D.C., MILLER, F.L., RUSSELL, R.H., and PARKER, G.R. - 1981
The Bailey Point Region and Other Muskox Refugia in the Canadian Arctic: A Short Review; *Arctic*, vol. 34, no. 1, pp. 34-36.

The muskox (*Ovibos moschatus*) is widely distributed over much of arctic Canada but only at a few locations do their densities remain high and populations relatively stable. These refugia constitute the most favourable muskox ranges in the Canadian Arctic Archipelago - places where muskoxen probably would survive under the most unfavourable climatic conditions. Extremes in winter weather cause other populations to ride a roller coaster of ups and downs with local exterminations. Refugia for muskoxen in the High Arctic include lowlands on eastern Axel Heiberg Island in the Mokka Fiord region, the lowlands of northeastern Devon Island, and the Bailey Point region of Melville Island. All of those regions historically have supported high densities of muskoxen from time to time but the Bailey Point region must be considered the best habitat for muskoxen in the Canadian High Arctic.

1922 THOMAS, D.C., and JOLY, P. - 1981
Status of Peary Caribou on the Western Queen Elizabeth Islands in April 1980; *Musk-ox*, vol. 28, pp. 58-64.

Reconnaissance surveys of the traditional wintering areas of Peary caribou (*Rangifer tarandus pearyi*) on Bathurst, Melville, and Prince Patrick islands provided no evidence that the caribou had begun to recover from the extremely low productivity of 1970-1977. Only 10 adults were observed and little sign. The 1980 population of adult Peary caribou on the western Queen Elizabeth Islands is estimated to number 634 individuals of which 549 occur on Melville, Eglinton, and Prince Patrick islands. The present sex ratio is calculated to be 1 male per 11.4 females, based on a ratio of 50 males: 100 females in 1974. The current estimate of 634 Peary caribou on the western Queen Elizabeth Islands compares unfavorably with estimates of 2,676 in 1974, 5,244 in 1973, and 24,320 in 1961. If our assumptions are correct one caribou remains for every 4.2 in 1974, 8.3 in 1973, and 38.4 in 1961.

1923 VINCENT, D., and GUNN, A. - 1981
Population Increase of Muskoxen on Banks Island and Implications for Competition with Peary Caribou; *Arctic*, vol. 34, no. 2, pp. 175-179.

Surveys were flown in March 1979 and 1980 north and south of 73°N on Banks Island to estimate numbers of muskoxen. Observed total was 11 809 animals and estimated population was 18 328 muskoxen, suggesting that the population has continued to expand since previous surveys in the early 1970s. A comparison with previous surveys of densities between the north and the south of the island indicates muskoxen have spread from the Thomsen River valley to the northeast and the south. Comparisons with muskox and caribou populations in Alaska and with reindeer in Greenland suggest that co-existence between these species is normal and does not involve competition.

1924 WAGEMANN, R., and LUTZ, A. - 1980
Selenium and Five Heavy Metals in Tissues of Narwhal (*Monodon monoceros*); *Fish. & Oceans* Internal Report, Freshwater Inst., 70 p.

This report represents the fulfillment of a Commitment made in November of 1979 to the Department of Indian and Northern Affairs to analyse approximately 300 sample of narwhal tissues for lead, zinc, cadmium, mercury, selenium and moisture, and to interpret the analytical data. The results of these analyses together with their interpretation are given in Part 1 of this report. In addition, the tissues have been analysed for copper, and these results are also given here. Analytical methods are described in Part II. A limited comparison of the plasma excitation-atomic emission method with the atomic absorpotion method has been carried out, with the results also being given in Part II of this report.

1925 WILLIAMS, S.R. - 1980
Preliminary Report of the Joint Services Expedi-

tion to Princess Marie Bay, Ellesmere Island, 1980; *Polar Cont. Shelf Proj.*, internal report, 51 p.

The three months duration of the expedition, from 21 May to 26 August, enabled projects to be run through the entire Arctic summer. There was full snow cover on arrival and we were able to establish and reconnoitre the area before migrant birds arrived and plants and insects emerged. The spring thaw took place between 15 and 26 June, but the sea ice continued to be safe for travelling until early July. At the beginning of August grey skies replaced the accustomed sunny conditions and we left as frost and snow reclaimed the country.

1926 WITTS, B., and MORRISON, R.I.G. - 1980
Joint Services Expedition to Princess Marie Bay, Ellesmere Island, 1980: Preliminary Report; *Water Study Group Bull.*, no. 30, pp. 34-35.

The Joint Services Expedition to Princess Marie Bay, Ellesmere Island, 1980 carried out a programme of biological work from late May to late August 1980 on the north side of Princess Marie Bay on the east coast of Ellesmere Island, N.W.T., Canada. The basis for the scientific programme was a study of the breeding biology of shorebirds in the area over a complete season, and this was supported by studies of the seasonal abundance of potential invertebrate food resources and of nesting habitat and habitat use.

1927 ZOLTAI, S.C., KARASIUK, D.J., and SCOTTER, G.W. - 1980
A natural resource survey of the Thomsen River Area, Banks Island, Northwest Territories; *Parks Can.*, internal report, 153 p.

The objectives of this study are: 1) To describe the geology, physical geography, flora, fauna, and human history of the study area; 2) To map and classify the vegetation types and ecological units of the study area; 3) To identify outstanding features and areas that might be critical to the management of a national park that includes all or part of the study area; and 4) To identify and propose boundaries for a preserve that might operate effectively under National Parks policy.

BOTANY

1928 ADDISON, P.A., and BLISS, L.C. - 1980
Summer climate, microclimate, and energy budget of a polar semidesert on King Christian Island, N.W.T., Canada; *Arctic and Alpine Res.* vol. 12, no. 2, pp. 161-170.

The climate, microclimate, and energy balance of a Lichen-Moss-Rush plant community in the vicinity of Cape Abernathy, King Christian Island (77°45'N, 101°10'W) are described. This community predominates in the polar semidesert areas of the north-central Queen Elizabeth Islands. The maritime summer climate is characterized by low temperature (2.5°C), low precipitation (43 mm), moderate average wind speed (5.9 m s^{-1}), high relative humidity (90%), and a high incidence of cloud and fog (80%). Different surface types had only a minimal effect on the near-surface environment as a result of an aerodynamically smooth surface and only very shallow gradients in temperature and moisture from surface to atmosphere. High atmospheric humidity and low temperatures predominate in the "free" air and combine with low incoming radiation to control surface energy relations.

1929 BELL, K.L., and BLISS, L.C. - 1977
Overwinter Phenology of Plants in a Polar Semi-desert; *Arctic*, short papers, vol. 30, no. 2, pp. 118-121.

Arctic and temperate-latitude tundra plants must make efficient use of the growing season, because it is very short. A variety of leaf-development strategies permit growth in the cool summers. Among these is the "wintergreen" growth pattern described by Sørensen. Wintergreen leaves begin to develop and partially expand during one summer, mature in the following summer and die at its end. Evergreen leaves are active for longer than two summers. Presumably, these phenological strategies represent an adaptation to a short, cold growing season in that plants are ready to begin photosynthesis in the spring, with minimal time spent in leaf expansion. By contrast, the leaves of summergreen plants develop, and complete their lives, during a single summer.

1930 BELL, K.L., and BLISS, L.C. - 1978
Root growth in a polar semidesert environment; *Can. J. Bot.*, vol. 56, no. 20, pp. 2470-2490.

Within the northwestern islands of the High Arctic, the vegetation and flora of King Christian Island are very representative. Five plant communities were recognized in a moisture gradient from a moss-rush moist meadow with 22 species of vascular plants and 13% cover (total plant cover 93%) to lichen barrens on low ridges with 8 species of vascular plants and 3% cover (total plant cover 24%). Root systems of 30 of the 34 known vascular plant species were examined. Root: shoot ratios (alive) are generally 0.2 to 0.7. Roots are estimated to live 1.5 years in *Phippsia algida*, 3.4-3.7 years in *Alopecurus alpinus* and *Puccinellia vaginata*, and 7-13 years in *Luzula nivalis*, *L. confusa*, and *Cerastium arcticum*. Optimal root growth occurs at 12 to 20°C but cold field soils (1 to 3°C) reduce these rates by 90%. Root growth was also reduced by low soil water potentials (< - 14 bars (1 bar = 100 kPa)), conditions seldom encountered in these sites. Limited root growth due to cold soils is combined with the adaptive advantages of small roots to produce small plants and sparse cover in these polar semidesert lands.

1931 BELL, K.L., and BLISS, L.C. - 1980
Plant reproduction in a High Arctic environment;

Arctic & Alpine Res., vol. 12, no. 1, pp. 1-10.

Studies of flowering, germination, and seedling survival were conducted in various stable and unstable soil (surface scraped and surface tilled) sites on King Christian Island, N.W.T., Canada. Although most species flowered, few set seed in 1973 or 1974. Germination was slow (3 to 6 weeks), occurring only after spring snowmelt or summer rains when there were thin films of standing water. Field germination percentages of nine species varied between 0 and 40% over 2 yr. Controlled environment tests suggested that low temperatures and slow imbibition were responsible for poor field germination. Annual seedling survival varied between 0 and 96% depending upon species, site, and year. Most seedling deaths appeared to result from summer drought. Reproduction by seed is a rare event in these polar semi-desert environments, yet vegetative reproduction is also uncommon. Most seedlings become established in moss or lichen mats and desiccation cracks where summer moisture is more constant.

1932 BLISS, L.C. - 1975
Truelove Lowland - a High Arctic Ecosystem; *in* Energy Flow - Its Biological Dimensions, eds. T.W.M. Cameron and W. Billingsley, Royal Soc. Can., Ottawa, 323 p.

The Canadian contribution to Productivity of Terrestrial Communities (PT), Tundra Biome, encompassed a study of the Truelove Lowland along the northeastern coast (75°33'N, 84°40' W) of Devon Island. This island forms the southeast corner of the Queen Elizabeth Islands and is fifth largest (54,000 sq.km.) of this northern group of islands within the Canadian Arctic Archipelago. The High Arctic Zone with its generally sparse plant cover and reduced diversity and density of animals, covers the entire Archipelago with the exception of the southern part of Baffin Island, whose mountain valleys fit within the Low Arctic Zone of the mainland. The major distinctions between the Low and High Arctic Zones are that the former has a longer and warmer snow-free season, a more complete cover of plants (except where Precambrian rocks outcrop in the eastern and central mainland arctic), low shrubs in many habitats, and a greater diversity of all animal and plant groups.

1933 BLISS, L.C. - 1979
Vascular plant vegetation of the Southern Circumpolar Region in relation to antarctic, alpine, and arctic vegetation; *Can. J. Bot.*, vol. 57, no. 20, pp. 2167-2178.

Classification of southern circumpolar vegetation has been based upon a system quite different than that used for alpine and arctic vegetation. Although the flora and in part the physiognomy of the vegetation is quite different in the Southern Circumpolar Region, it is felt that a more uniform classification system is needed.

This paper subdivides the vegetation of the southern polar region into a Subantarctic and an Antarctic Biome. The former includes closed forest, scrub fern bush, maritime and montane tussock grassland. The Antarctic Biome includes tundra-like closed vegetation, cushion plant open fellfield, and the grass-herb fellfield, moss and lichen communities of the Antarctic Continent and adjacent islands.

1934 BLISS, L.C. - 1979
Vegetation and revegetation within permafrost terrain; *in* Proc. Third Int. Conf. Permafrost, Nat. Res. Council, Ottawa, vol. 2, pp. 31-50.

Permafrost, both continuous and discontinuous, covers vast areas within circumpolar lands. All of the arctic tundra, polar semi-deserts and polar deserts are underlain by continuous permafrost. To the south, the forest-tundra transition and the northern portion of the open forest, generally a spruce-lichen woodland in North America and a larch-lichen woodland in Siberia, occur on continuous permafrost. The northern portion of the taiga or closed boreal forest is also underlain by continuous permafrost. Much of the remaining taiga is found on discontinuous permafrost, especially in uplands and poorly drained areas.

The relationship of vegetation to permafrost on a macro-scale and plant communities to depth of the active layer on a micro-scale, has been of interest to ecologists for a number of years. Studies of vegetation in relation to permafrost and terrain have taken on a new meaning with the increased pace of northern development.

The objective of this paper is to describe the vegetation patterns within the taiga, Low, and High Arctic as they relate to topography and drainage as influenced by permafrost and depth of the active layer.

The role of species useful in rehabilitating surface disturbed northern lands will also be discussed in relation to northern development.

1935 COURTIN, G.M., and MAYO, J.M. - 1975
Arctic and alpine plant water relations; *in* Physiological Adaptation to the Environment, ed. F. John Vernberg, Intext Educational Publishers, New York, N.Y., pp. 201-224.

This chapter reviews recent information concerning arctic and alpine plant water relations and compares physiological adaptations to environmental stress where possible. Information which is not recent will be used as needed. A second purpose is to call attention to areas of arctic and alpine plant water relations where more information is desirable.

1936 CWYNAR, L.C., and RITCHIE, J.C. - 1980
Arctic Steppe-Tundra: A Yukon Perspective; *Science*, vol. 208, pp. 1375-1377.

The first reliable, securely dated full- and late-glacial pollen stratigraphy from Eastern Beringia forces the rejection of the widely held hypothesis of a steppe-tundra or grassland associated with extinct vertebrates and early humans. The arctic-alpine fossil flora and low pollen influx suggest a sparse tundra similar to modern herb fell-field vegetation.

1937 GIZYN, W.I. - 1980
The chemistry and environmental impact of the bituminous shale fires at the Smoking Hills, N.W.T.; unpub. M.Sc. Thesis, Univ. Toronto, 216 p.

Bituminous shale deposits are exposed along sea-cliffs on the eastern side of the Cape Bathurst peninsula in the western Canadian Arctic in the area known as the Smoking Hills. These deposits are undergoing spontaneous combustion in places. The resultant emissions, in the form of smoke plumes, consist of SO_2, acid aerosols, particulates and water vapour. These emissions are distributed over the adjacent tundra by on-shore winds. The chemical nature of these emissions, their magnitude and spatial distribution and their effect on the terrestrial environment are examined in this thesis.

Spatial distribution and concentration patterns of SO_2 have been determined by the sulphation plate technique in 1975 and 1977. (8 and 14 day exposure periods). Short term peak concentrations during on-shore fumigations were determined by a SO_2 scrubbing-colourimetric technique. Good agreement between the methods was obtained. Ground level SO_2 concentrations approaching 1 ppm are common within 40 meters of the cliff edge but decline rapidly with distance. A concentration of 0.05 ppm SO_2 at 2 km is typical. Such concentrations can be regarded as annual means but depend strongly on wind direction.

The distribution of vegetation at the fumigated site can be related to the SO_2 concentration gradient. While the most highly exposed areas are completely devoid of vegetation and suffer soil erosion, certain plant species exhibit distinct tolerance to normally phytotoxic SO_2 concentrations. These include the flowering plants *Artemisia tilesii*, occurring within 80 meters of the cliff edge, and *Arctagrostis latifolia*, within 160 meters. The lichen, *Cladonia bellidiflora* is notable as it is the species occurring closest to the source and tolerating SO_2 levels of about 0.1 ppm for extended, if not indefinite, periods.

Aerial deposition of sulphate and H^+ ions (onto the tundra) was determined by precipitation-dustfall collections. Sulphate deposition rates of 0.2 to 0.4 mg $SO_4^{=}/cm^2/30$ days were recorded at 40 meters but decline to less than 0.1 mg $SO_4^{=}/cm^2/30$ days at 640 meters. The higher figures are in general agreement with sulphate occurrences near industrial, point sources of sulphur emissions. The deposition is distinct from other polluted areas since the deposited species appears to be pure sulphuric acid. Essentially all the sulphate is stoichiometrically balanced by H^+ ions.

Element concentrations in aerodynamically-sized particulates can be attributed to each of soil dust, ocean sources and shale fire sources. Elements contributed by the shale fires include Cl, Br, As, Sb, V, Mn, Se and S. Only selenium and sulphur occur in sufficient quantities to be called excessive as compared to other polluted (industrial) sites. Analysis of materials collected at the source of the emissions has been used to confirm the constituents of the emissions in a qualitative manner.

Soil samples taken from profiles in the fumigated area revealed various degrees of acidification. Surface layers have a pH of 3 or less while deeper increments reach a pH of 7.0. Control site soils also have a pH of 7 or greater.

As a result of the surface loading of acid, many soil constituent elements have been mobilized and re-distributed within (or removed from) the soil profile.

Calcium has been removed from the acid increments to the greatest degree. Concentrations of 0.5% occur in the acid soils while the neutral soils still retain concentration in excess of 3%. Magnesium also shows a depletion although less dramatic.

Aluminum and iron show an accumulation in the acid surface increments. It is suggested that extensive erosion in the denuded area is responsible for removing the most acidic, aluminum and iron depleted surface soil. Thus the elevated aluminum and iron samples represent reprecipitation sites of these leached elements. This process has doubled aluminum and iron concentrations in the 'surface' soil.

Trace element distributions are aligned to aluminum and iron and probably represent releases and reprecipitation by acid weathering of clay minerals. Aerial deposition (from the emissions) are not considered responsible for the observed surface enrichment of trace elements. Sulphur and H+ ions are the only surface soil enriched elements which can be attributed to direct aerial deposition.

Changes in elemental composition of surface (2 cm) soils with distance from the source were not apparent. High variability and more or less equal degree of acidification within the length of the transect lines eliminates potential trends. Erosion disturbance further disguises such anticipated trends.

1938 HARTGERINK, A.P., and MAYO, J.M. - 1976
Controlled-environment studies on net assimilation and water relations of *Dryas integrifolia*; *Can. J. Bot.*, vol. 54, no. 16, pp. 1884-1895.

Net CO_2 assimilation and water relations of *Dryas integrifolia* from Devon Island, N.W.T. were studied under controlled-environment conditions. Maximum net CO_2 assimilation rate for single leaves was 18.7 mg $g^{-1}h^{-1}$. The optimum leaf temperature for net CO_2 assimilation was between 9 and 14°C. Positive net CO_2 assimilation occurred at -5°C. Respiration and net CO_2 assimilation decreased with the onset of dormancy. Dark respiration was generally equal to or greater than that of other arctic and alpine species. The mean leaf water potential of actively growing plants was - 11.4 bars. Values higher than - 7 bars were found only infrequently. Turgor pressure was maintained at high values (+6 to+10 bars) over a wide range of water potentials, suggesting osmotic adjustment to soil moisture deficit.

1939 HAVAS, M. - 1980
A study of the chemistry and biota of acid and alkaline ponds at the Smoking Hills, N.W.T. unpub. Ph.D. Thesis, Univ. Toronto, 195 p.

Sulphur dioxide and sulphuric acid aerosols, emitted from spontaneously burning bituminous shales at the Smoking Hills, have significantly altered nearby tundra ponds. The antiquity of these burns, the intensity of the emissions, and the relatively localized but severe effects have produced an ideal field-laboratory for the study of the long term consequences of acidification.

Many of the once alkaline ponds have become acidic. A bimodal pH distribution of the ponds shows peaks at pH 8 and pH 3, which correspond to the two dominant buffering systems (HCO_3 and Al/Fe) in this area. Metal concentrations (Al, Fe, Mn, Zn, Ni, Cd) are elevated in the acidified ponds, especially below pH 4.5. Changes in pH, Ca, Mn, Al, U, V, and Ba concentrations, in the soils and sediments, relate to aerial deposition and differential leaching rates.

Biological diversity is significantly reduced in the acidified ponds. The few species that can survive are abundant. These include the alga *Euglena mutabilis*, the mosses *Drepanocladus exannulatus* and *Leptodictyum riparium*, the rotifer *Brachionus urceolaris*, and the red Diptera *Chironomus riparius*.

Crustaceans are rare or absent from acidified ponds. Bioassays revealed that crustaceans were sensitive to pH below 4.5. Insect larvae, in contrast, were considerably more tolerant. Metals, especially Al, increased the toxicity of the acidified pond water.

Acid-sensitive invertebrates were unable to regulate osmotically important elements of low pH. The net loss of sodium by *Daphnia* was due primarily to an accelerated rate of sodium loss (using ^{22}Na). Sodium uptake was also affected, but only at very low pH's ($\leq$ pH 3.5).

Daphnia middendorffiana was able to recover following brief exposure to pH 4.0 when restored to a neutral solution. Secondary fungal infection was observed and may interfere with long-term survival in acid waters.

The long-term consequences of acid precipitation on freshwater ecosystems are considered based on observations at the Smoking Hills. Effects of hydrogen ions on sodium regulation, oxygen metabolism, calcium dynamics, and acid-base balance by aquatic animals are discussed.

1940 HODGSON, D.A., and EDLUND, S.A. - 1978
Surficial materials and vegetation, Amund Ringnes and Cornwall Islands, District of Franklin; *Geol. Surv. Can.*, Open File No. 541.

This file consists of preliminary drafts of two maps and a separate legend describing surficial materials of 59C and F (W½), and 69D (NE3/4) based on airphoto interpretation and field data collected in 1977-78 at a scale of 1:125 000.

1941 HUTCHINSON, T.C., and KUJA, A. - 1979
Selection and use of multiple-metal tolerant native grasses for re-vegetation of mine tailings; *in* Management and Control of HEAVY METALS in the ENVIRONMENT, ed. R. Pery, Imperial College, London, U.K., September 1979, pp. 191-197.

A large number of mine tailings sites occur in Canada, covering many thousands of acres. All such sites at active mines are now under regulations requiring their restoration and re-vegetation after the mining ceases. This is a serious challenge, as well as a considerable expense, since many tailings areas are of extreme acidity, contain high concentrations of toxic heavy metals and are nutrient deficient and drought prone. Normal agricultural techniques aim at converting the tailing to a chemical substratum suitable for plant growth, notably through lime and fertilizer additions. The high acid-generating potential of many tailings causes the site to revert to acid conditions after a few years. In the present study native grass species have been selected from natural sites of extreme acidity and metal concentrations. Field and laboratory trials have shown the high potential of some of these plants, notably *Arctagrostis latifolia* and *Deschampsia cespitosa* to survive and establish on un-amended tailings sites. Acid-tolerant and multi-metal tolerant races can be selected and developed from the wide genetic diversity present in native plant populations for low cost, long term re-vegetation of sites difficult or impossible to handle using regular agricultural techniques.

1942 KOERNER, R.M. - 1980
The problem of lichen-free zones in Arctic Canada; *Arctic & Alpine Res.*, vol. 12, no. 1, pp. 87-94.

The origin of lichen-free areas in the High Arctic has been attributed to lichen-kill under permanent snowfields developed 300 yr ago during the Little Ice Age. There are inconsistencies in this hypothesis, particularly in regard to the manner of lichen-kill, the mechanism of dead lichen removal once the previously ice-covered ground is exposed again, the period when the lichen-kill occurred, and the form of lichen trimlines. An alternative hypothesis is suggested whereby lichen-free areas occur where seasonal snowfields persist for a much greater part of the summer than elsewhere. As a result the lichen growth season there is very short.

1943 LEE, R.K.S. - 1980
A Catalogue of the Marine Algae of the Canadian Arctic; *Nat. Museum Nat. Sci.*, Pub. Botany No. 9, 82 p.

Benthic marine algae collected by scuba and dredging from 105 sites mostly in the northern and southwestern part of the Canadian Arctic are identified and catalogued with selected literature references, habitat notes, and frequency of occurrence. Each species is provided with a list of collection sites and herbarium reference numbers to voucher specimens. Included are species distribution records that have been reported in the literature. Of the 183 species and varieties from a total of 113 genera of Chlorophyta, Phaeophyta, and Rhodophyta, 37 are newly reported from the Canadian Arctic.

1830 McCARTNEY, N.G. - 1978
Lichens from Three Archaeological Sites, Somerset Island, N.W.T., Canada; *The Bryologist*, vol. 81, no. 4, pp. 610-613.

1944 SVOBODA, J., and FREEDMAN, B. - 1980
Ecology of a High Arctic Lowland oasis, Alexandra Fjord (78°53'N, 75°65'W), Ellesmere Island, N.W.T., Canada; *Univ. Toronto & Dalhousie Univ.*, Progress Report of Alexander Fjord Lowland Ecosystem Study, 109 p.

Very few intensive studies in Ecosystem ecology have been conducted in the Canadian High Arctic. The only comprehensive study which has been completed to date was located at Truelove Lowland, on Devon Island. This dearth of information relevant to the ecology of the high arctic archipelago is significant, in view of the tremendous geography of this region, the sensitivity of the systems, and the scope of disturbance that could arise from northern resource development.

Most of the Arctic Archipelago north of Lancaster Sound is classified as polar desert or semi-desert, or is covered by ice fields. These are xeric, barren, and highly unproductive regions. However, certain localities generally infrequent in occurrence and small in size, have developed into relatively lush and productive ecosystems. These are usually uplifted lowlands, having favourable microclimates and moisture regimes, and are termed high arctic lowland oases. Virtually all of the resident and migratory terrestrial arctic wildlife depends on the primary production of these infrequent sites for their survival.

In order to contribute further information on the ecology of these rare Bio-enclaves we initiated in 1979, an intensive study of a lowland adjacent to Alexandra Fjord at Ellesmere Island. This site, in addition to being an exceptional example of a lowland oasis, also has the great logistic advantage of accessibility and accommodation in an abandoned RCMP post.

The overall objectives of this project are to determine the environmental factors, which influence plant diversity and primary production in the lowland, anomalously located in a region otherwise surrounded by barren polar desert and glaciers. Within the scope of these objectives we are carrying out studies of meso- and microclimate, soils, composition, distribution and production of plant communities and the autecology of certain plant species.

The site is suitable for another important reason. Alexandra Fjord is at present the Northernmost Canadian Arctic Ecology Research Training base for young scientists.

1945 SWALES, D.E. - 1979
Nectaries of certain Arctic and sub-Arctic plants with notes on pollination; *RHODORA*, vol. 81, no. 827, pp. 363-407.

The nectaries, stamens, and pistils of the most common genera and species of seventeen Arctic and sub-Arctic families were studied from living material at Frobisher Bay, Resolute, Inuvik, and Tuktoyaktuk, N.W.T., and at Keno Hill, Dawson City, and Whitehorse, Y.T.

The study was initiated by the growing interest in the pollination of arctic plants, and importance of self-pollination, apomixis, and polyploidy in areas where weather conditions often reduce the numbers and activity of pollinating insects. There is a singular lack of detailed information on the position and type of nectaries and the mechanics of self- and cross-pollination in Nearctic plants.

The theory that nectaries in the primitive families usually occur on the outside whorl, and migrate to the base of the style in the most advanced, was evaluated in the seventeen arctic families, as well as the adaptations of the flower to facilitate either cross- or self-pollination.

An account of nectar and nectaries in the arctic flowers would be incomplete without reference to the type of insects involved in pollination in the areas where the field work was undertaken. Insects were collected from individual flowers in the relatively few species which were visited freely by them. Insect names were added to plant species' discussion, along with some data collected by others in a much more severe weather area further north, Ellef Ringnes Is., where the insects crawled rather than flew to their nectar food source, playing a part in the survival of the 49 species of flowering plants recorded there.

1946 VITT, D.H. - 1975
A key and annotated synopsis of the mosses of the northern lowlands of Devon Island, N.W.T., Canada; *Can. J. Bot.*, vol. 53, no. 19, pp. 2158-2197.

The moss flora of the northern lowlands of Devon Island (75°33'N, 84°40'W) is reported to consist of 131 species and 2 varieties. Forty-five of these are reported as new to the island. *Sphagnum orientale* L. Savicz is reported as new to North America and *Plagiobryum zierii* (Hedw.) Lindb. and *Polytrichum algidum* Hag. & C. Jens. are reported as new to the Queen Elizabeth Islands.

A key is given to the species and varieties, which is followed by a discussion of critical taxonomic and ecologic criteria for each species.

1925 WILLIAMS, S.R. - 1980
Preliminary Report of the Joint Services Expedition to Princess Marie Bay, Ellesmere Island, 1980; *Polar Cont. Shelf Proj.*, internal report, 51 p.

1927 ZOLTAI, S.C., KARASIUK, D.J., and SCOTTER, G.W. - 1980
A natural resource survey of the Thomsen River Area, Banks Island, Northwest Territories; *Parks Can.*, internal report, 153 p.

CLIMATOLOGY

1928 ADDISON, P.A., and BLISS, L.C. - 1980
Summer climate, microclimate, and energy budget of a polar semidesert on King Christian Island, N.W.T., Canada; *Arctic & Alpine Res.*, vol. 12, no. 2, pp. 161-170.

1947 ALBRIGHT, M. - 1980
Geostrophic Wind Calculations for AIDJEX; *in* Sea Ice Processes and Models, Proc. Arctic Ice Dynamics Joint Experiment, Intern. Comm. Snow & Ice Sym., ed. R.S. Pritchard, Univ. Wash. Press, Seattle, pp. 402-409.

Surface pressure maps were constructed four times daily for the duration of the main AIDJEX experiment. A two-dimensional polynomial was fitted to the pressure data by the least squares method.

The pressure measurements used in the analysis are accurate to ±0.3 mb. The geostrophic winds calculated from the pressure maps are estimated to be accurate to ±0.7 m/sec in speed and ±5° in direction. Statistics of the calculated geostrophic winds and the observed surface winds are presented in graphs for summer, winter, and the entire year of the experiment.

1948 ALT, B.T. - 1979
Investigation of Summer Synoptic Climate Controls of the Mass Balance of Meighen Ice Cap; *Atmosphere-Ocean*, vol. 3, pp. 181-199.

The Meighen Ice Cap synoptic climate classification system, developed from the study of six years of summer meteorological and glaciological observations, appears to account for significant variations in the energy- and mass-balance climates of the ice cap. In relating the summer frequency of the three synoptic types to fourteen years of mass-balance measurements, it was found that variations in surface conditions, solar angle and type of precipitation could be accounted for by the relative sequence of synoptic types. Further it was shown that the types could be represented by the position of the dominant 500-mb cold Low influencing Meighen Island, thus providing a link between the mass balance and the general circulation.

Dominance of the winter pattern of a 500-mb Low in the Hudson Bay - Baffin Island region throughout the summer season is capable of maintaining Meighen Ice Cap at its present size. A shift of the 500-mb Low from the winter position directly to the Beaufort Sea or adjoining Polar Ocean area is capable of increasing the size of the ice cap. On the other hand, a shift of the 500-mb vortex to the Asiatic side of the Polar Ocean before taking up position in the Beaufort Sea - Polar Ocean area produces negative mass-balance conditions. When the 500-mb Low remains on the Asiatic side of the Polar Ocean during most of the summer season the slow accumulation of two decades of Polar Ocean years is destroyed.

1949 BRADLEY, R.S., and ENGLAND, J. - 1979
Synoptic climatology of the Canadian High Arctic; *Geogr. Ann.*, vol. 61 A, no. 3-4, pp. 187-201.

An objective classification of daily weather maps for the Canadian High Arctic was developed with a view to identifying those synoptic situations which greatly affect ablation season temperatures and annual precipitation totals. This classification was used to catalog synoptic types for the period January, 1946 to August, 1974. 22 basic types were recognized, accounting for ~96% of days in the period. Most types have distinct seasonal maxima. Using data from Alert, Isachsen and Thule, monthly mean temperature characteristics of the types were obtained, enabling them to be ranked, warmest to coldest. Although "warm" and "cold" types were different for each station, the circulation characteristics of cold types, and of warm types, were similar. Stepwise, multiple regression analysis was used to indicate the synoptic types which are closely related to inter-annual variations of mean monthly maximum temperatures. Generally, the maximum reduction of variance in the temperature record was achieved with a minimum number of synoptic types in the months April-August, suggesting greater "control" on temperature by a few types in spring and summer months. Ablation season climatic data were used to identify synoptic types which were "cool and wet", "warm and dry", "cool" and dry" or "warm and wet". Cool, wet types have increased in frequency over the last 10-15 years whereas warm, dry types were slightly less frequent. Such changes are not sufficient to account for the deterioration in summer climate of the area in the 1960s; within-type changes are probably significant factors in this deterioration.

Stratification of precipitation data by synoptic type indicates a small number of types account for most of the annual precipitation at each station, though this is really a function of type frequency. Other, less frequent, types are more efficient precipitation-bearing situations, in terms of precipitation per day of type occurrence. In many of these situations, low pressure close to the station dominates the circulation; these may be North Atlantic depressions regenerated along the Siberian coastline. Even small changes in the frequency of these systems would have important consequences for High Arctic precipitation.

1950 FISHER, D.A., and KOERNER, R.M. - 1981
Some Aspects of Climate Change in the High Arctic During the Holocene as Deduced from Ice Cores; *in* Quaternary Paleoclimate sym., May 1979, ed. W.C. Mahaney, Geo abstracts, pp. 249-271.

Time series of climate-related variables obtained from Greenland and Arctic Canada are presented and compared to each other and to other climate-related time series. Oxygen isotope ratios from the Devon Island Ice Cap are shown to provide a detailed proxy temperature record of a 2 - 3°C cooling over the last 5000 years. They also contain variations in anti-phase with ^{14}C production rates, thus lending some support to the solar-constant theory of climate change. Insoluble microparticle concentrations and acidity of the Devon ice core samples are nearly constant over the last 5000 years, suggesting that atmospheric turbidity and volcanic activity have not been the primary controlling mechanisms in the cooling since the climatic optimum 5000 years ago. There is a significant trend of decreasing ionic content of the ice, which is explainable in terms of decreasing availability of marine-derived salts and sulphates and/or decreasing cloudiness over the 5000 years of record.

The data representing the last 500 years are examined in detail and both the $\delta(^{18}O)$, and the varying amounts of ice layering, attest to the unique coldness of the Little Ice Age some 200 years ago, and the equally unique warmth of the first half of the present century. A preliminary study of acid layers, $\delta(^{18}O)$, and melt layers in the cores, lead the authors to conclude that it is dangerous to assume that volcanic activity has caused major temperature fluctuations in this 500-year interval.

1951 HOBSON, G.D. - 1981
Climatic Change in Canada 2; Preface, *SYLLOGEUS*, no. 33, Mus. Nat. Sci., ed. C.R. Harington, p. 4.

1952 KATZ, D.I. - 1980
Air Stress Measurements from an Aircraft; *in* Sea Ice Processes and Models, Proc. Arctic Ice Dynamics Joint Experiment, Intern. Comm. Snow & Ice Sym., ed. R.S. Pritchard, Univ. Wash. Press, Seattle, pp. 452-463.

As part of the air stress measurement program of AIDJEX, the NCAR Electra was flown in the planetary boundary layer (PBL) over the AIDJEX manned-camp array on 19 July 1975. An on-board inertial navigation system and gust probe allowed high frequency (20 Hz) measurements of the three wind components (u,v,w) and air temperature. Other standard meteorological parameters were measured at 1 Hz. Vertical profiles of mean winds and temperature are presented. Processing of the data was required to remove aircraft motions, trends, and spikes from all of the 20 Hz time series. The processed data were then analyzed to construct horizontal and vertical profiles of the air stress, $u_*(z)^2 = -_{\tau u/p} = \overline{u_i u_j}$, and the geostrophic drag coefficient, $C_g = u_*(0)/G$.

1953 KOERNER, R.M. - 1980
Basal ice and paleoclimate; *Abstract in* EOS, vol. 61, no. 5, Abstracts of American Geophys. Union Annual Meeting, p. 50.

A series of ice cores from two Canadian High Arctic ice caps have given insight into the nature of the ice/bedrock interface there, both past and present. Three of these cores (two are 299 m and one 337 m long), located 1-2 km down the flowline on Devon Island and northern Ellesmere Island, show there is a sharp interface between bedrock and basal ice. There are no rock fragments or floor frozen within the ice. The evidence strongly points to the ice caps having been frozen to their beds throughout their 100,000 year history. Another core (137 m long), taken this May, 1979, at the top of the flowline on a northern Ellesmere Island ice cap, contained 2.75 m of ice containing a high clay fraction at its base. The nature of the inclusions suggests substantial bottom melting of the ice cap at some stage during its history. The present interpretation is that this dirty basal ice at the top of the present northern Ellesmere ice cap flowline dates from a pre-Wisconsin ice age when the ice cap was thick enough to melt at its bed. It has survived the Sangamon interglacial, unlike the very old ice at the other downslope sites, because of the greater elevation of the bedrock at the upper site. It means that the Wisconsin ice sheet was substantially thinner on Ellesmere Island than the earlier ice sheet. It also means that the ice caps expanded downslope during what is presently identified as an interglacial period preceding the Wisconsin ice age.

1954 KOERNER, R.M., and FISHER, D. - 1980
Liquified natural gas tanker transport through Parry Channel and climatic change; *Polar Cont. Shelf Proj.*, internal report, 32 p.

This report is concerned with the navigability of the channels in the Queen Elizabeth Islands, both now and in the future, with particular reference to the shipping of liquified natural gas (LNG) in ice-protected tankers.

1955 KOERNER, R.M., and FISHER, D.A. - 1981
Studying climatic change from Canadian High Arctic ice cores; *SYLLOGEUS*, no. 33, Mus. Nat. Sci., ed. C.R. Harington, pp. 195-218.

The accumulation regions of ice sheets and ice caps are repositories of past atmospheres. This is because as snow falls in the upper and colder regions of ice sheets it includes with it, as it accumulates, some of the air at the surface and also aerosols from the atmosphere. The snow grains themselves contain impurities from the air gathered either as a nucleus or by a sweeping action during their fall at the time of precipitation. The ratios of the various isotopes in the water molecule (specifically DH (deuterium, an isotope of hydrogen), ^{16}O, ^{18}O)) depend on the temperature at the condensation level when the snow falls. Therefore, if we take a core section in an area where the ice flow is least complex so that the accumulated layers are not mixed up by folding or faulting we can study both the changing temperature of condensation and atmospheric content back in time.

The time scale resolution depends on the accumulation rate of snow at the surface and also on the degree of summer melt. So an ideal drill site should be at the top of the flowline with an accumulation of about $20\ g\ cm^{-2}\ y^{-1}$ (grams per square centimetre per year) or more and very little melt. Some High Arctic ice caps provide such conditions. A record of over a million years of accumulation is claimed for ice in Antarctica. The High Arctic Canadian ice caps span much less than this, about 100,000 or 200,000 years.

1956 KOERNER, R.M., and FISHER, D. - 1981
Update on LNG Transport through Parry Channel - A Climate Forecast; *Polar Cont. Shelf Proj.* internal report, 15 p.

Our original report on the liquified natural gas (LNG) transport through Parry Channel depended for its data base on the two surface-to-bedrock cores from the Devon Island ice cap. This appendix to that report is intended to make use of additional data from a northern Ellesmere core and determine whether the new and extended data base alters our climate forecasts for the High Arctic.

1957 MARTIN, P., CLARKE, M., SHORT, D., and ALBRIGHT, M. - 1980
One Year of Barometry on the Frozen Ocean; *in* Sea Ice Processes and Models, Proc. Arctic Ice Dynamics Joint Experiment, Intern. Comm. Snow & Ice Sym., ed. R.S. Pritchard, Univ. Wash. Press, Seattle, pp. 410-418.

To provide data for estimating geostrophic wind, surface measurements of atmospheric pressure were made from an array of buoys and camps in the Beaufort Sea during the AIDJEX main experiment. Accuracy to about 0.1 mb was desired to permit accurate wind vectors to be computed with pressure differences between sampling stations of 10 mb or less.

The best commercially available electronic barometers suitable for this application were used in the data buoys at eight sites in the Beaufort Sea. Aneroid barometers and microbarographs were used at the manned camps. A set of barometers (flight package) was maintained at the main camp and calibrated to a laboratory-quality mercury barometer. The flight package was flown to the buoy sites for *in situ* calibrations at the beginning and end of the experiment. An analysis of these checks, together with a comparison of the readings of the buoy barometers, permitted calibrations to be maintained over the course of the experiment which appear to be accurate to about 0.3 mb. The flight package barometers were also compared with instruments at one U.S. and three Canadian weather stations. The agreement was generally within 0.2 mb.

1958 MÜLLER, F., STEFFEN, K., OHMURA, A., SCHROFF, K., and BLATTER, H. - 1978
Fernerkundungsflüge über der North Water Polynya; *Kurzfassungen*, 11, Internationale Polartagung, Berlin.

Im Rahmen des North Water-Projektes wurden im nördlichen Teil der Baffin Bay, Zwischen Grönland und Ellesmere Island, klimatologische und glaziologische Untersuchungen, sowie eine Studie Uber die Entwicklung, die räumliche Verteilung und die Oberflächentemperatur verschiedener Meereistypen durchgeführt.

1959 MÜLLER, F., BERGER, P, ITO, H., OHMURA, A., SCHROFF, K., and STEFFEN, K. - 1980
Glaciological and Climatological Investigation of the North Water Polynya in Northern Baffin Bay; A Report on North Water Project Activities, April 1, 1978 to December 31, 1979, internal report, 123 p. *NOT FOR PUBLICATION*

1960 OHMURA, A. - 1972
Heat and water balance on arctic tundra; *in* Proc. 22nd Intern. Geographical Congress, eds. W. Peter Adams and Frederick M. Helleiner, Trent Univ., Univ. Toronto Press, pp. 175-176.

While the knowledge of climate increases, the interaction between the high arctic surface and the atmosphere still remains, in many respects, unknown. Axel Heiberg Island Expedition of McGill University carried out continuous measurements of heat balance at the base camp (79°25'N, 90°30'W) on Axel Heiberg Island, N.W.T., Canada. The period of the measurements was 3 May - 23 August 1969 and 23 April - 23 August 1970. The present paper reports the procedure of the observation and a part of the results which are already analysed together with the supplementary data of water balance.

1961 OHMURA, A., and MÜLLER, F. - 1977
Die mesoklimatische Verteilung von Luft-temperatur und Niederschlag über der hocharktischen Tundra von Axel Heiberg Island, N.W.T., Kanada; *Geographica Helvetica*, Nr. 4, Jg. 32, pp. 185-194.

1961 OHMURA, A., and MÜLLER, F. - 1978
Aspects of mesoclimatic distribution of air temperature and precipitation over high arctic tundra, Axel Heiberg Island. N.W.T., Canada; *Polar Geography*, vol. 4, pp. 270-284; translated from Geographica Helvetica, vol. 4, Jg. pp. 185-194.

While there have been numerous studies of tundra climates, they have been confined almost entirely to sea-level stations and to coastal areas, largely due to the availability of appropriate data, controlled in turn by the distribution of weather and research stations. The authors have attempted to rectify this situation by an analysis of data from nine climatological stations distributed over some 40 km^2 of west central Axel Heiberg Island, N.W.T., and ranging in altitude from sea level to 800 m. Temperature and precipitation data are analysed for the summer months (May-August), the specific parameters under consideration being daily maximum temperature, daily minimum temperature, daily temperature range, diurnal amplitude, aperiodic daily temperature change and precipitation. The aspects of length of frostfree period and number of freeze-thaw cycles are also examined. In every case spatial variations in these various parameters are examined in terms of altitudinal variations.

1962 OHMURA, A., and MULLER, F. - 1978
Regional water balance for arctic tundra, Axel Heiberg Island, N.W.T., Canada; *Internationale Polartagung*, vol. 11, Berlin.

1963 OHMURA, A. - 1981
Climate and Energy Balance on Arctic Tundra, Axel Heiberg Island, Canadian Arctic Archipelago, Spring and Summer, 1969, 1970 and 1972; *Geographisches Institut der Eidg. Technische Hochschule*, Zürich, Heft 3, 449 p.

The summer climate and the energy and water balances in the interior tundra region on Axel Heiberg Island, N.W.T. are described. The climate of the region is compared with those in the other regions of the arctic tundra, coastal zone, Polar Ocean and glaciers. The main characteristics of the climate and energy balance for the tundra region are identified. The characteristics of the tundra climate emerge during the melt and become most distinctive during the snow-free period. The main features of the tundra climate are higher air temperature, larger daily temperature range, longer frost-free period, less freeze-thaw exchange days, lower relative humidity, higher specific humidity, longer sunshine duration, less total cloud amount, less frequent occurrence of Sc, St and fog, higher frequency of Cu and less wind speed. The climate becomes considerably milder closer to the surface. The seasonal and diurnal variations in the main climatic elements were presented for sites ranging in altitude from sea level to 800 m a.m.s.l.

1964 PAULSON, C.A. - 1980
A Review of the AIDJEX Atmospheric Program; *in* Sea Ice Processes and Models, Proc. Arctic Ice Dynamics Joint Experiment, Intern. Comm. Snow & Ice Sym., ed. R.S. Pritchard, Univ. Wash. Press, Seattle, pp. 28-33.

The principal objective of the atmospheric program in AIDJEX was twofold: to provide estimates of the surface wind stress suitable for testing models of the ice dynamics; and to derive methods of estimating the surface wind stress from easily measured variables, such as the surface pressure field. The approach taken was to make measurements of the surface pressure field coupled with direct or nearly direct measurements of surface stress and planetary boundary layer structure at a few locations. These measurements were then used to construct models relating the surface stress to the geostrophic wind and other boundary layer parameters.

Apart from the desirability of providing surface stress estimates for ice models, the investigation of the Arctic planetary boundary layer is of interest in its own right. The Arctic is probably the best place in the world to investigate the stably stratified planetary boundary layer. Diurnal effects are absent during the polar night and the mean slope of the ice is zero, eliminating bothersome gravity-driven winds which frequently occur over land.

This paper describes the atmospheric observations made during AIDJEX and summarizes the results of the analyses thus far. It serves as an introduction to the other meteorological papers in this volume.

1925 WILLIAMS, S.R. - 1980
Preliminary Report of the Joint Services Expedition to Princess Marie Bay, Ellesmere Island, 1980; *Polar Cont. Shelf Proj.*, internal report, 51 p.

1965 WOO, M-K., and STEER, P. - 1979
Measurement of Trace Rainfall at a High Arctic Site; *Arctic*, vol. 32, no. 1, pp. 80-84.

Trace rainfall is defined as rainfall under 0.2 mm (or 0.05 in) which cannot be measured by conventional types of rain-gauges. In the Canadian Arctic Islands, trace rainfall is commonly reported by the government weather stations or by researchers in the field. Frequent occurrence of such events is attributed to the moisture provided by the open water areas and melting snow. To date, however, the measurement of trace rainfall has not been attempted. In view of low rainfall in the High Arctic, the exclusion of trace rainfall can possibly cause an underestimation of summer precipitation. The purpose of the present study is to determine the magnitude of several trace rainfall events using a simple device modified after one designed to study fog.

EQUIPMENT

1966 ANONYMOUS - 1982
Remotely piloted vehicle success on Arctic Expedition; *Benthosaurus*, News from Benthos Inc., vol. 15, pp. 2-3.

The Benthos RPV-430 Remotely Piloted Vehicle was put to the ultimate test this fall when it was taken to the Arctic for a dive to the site of the H.M.S. *Breadalbane*, a three masted vessel that 128 years ago was holed by the ice and sank in 330 feet of zero degree water.

1967 DAVIES, P.V. - 1979
Arctic Survey Uses Helicopter Mounted Spike Transducer; *Lighthouse*, no. 20, November 1979, pp. 20-21.

1968 DOAKE, C.S.M., and GORMAN, M. - 1979
Instruments and Methods - Performance of V.H.F. Aerials Close to a Snow Surface; *J. Glaciology*, vol. 22, no. 88, pp. 551-553.

Measurements of aerial admittance as a function of height above a snow surface show that when the surface temperature is below freezing, the aerial performance is insensitive to slight surface irregularities.

1969 INTERNAV LTD. - 1981
Beaufort Sea Loran-C Accufix Evaluation, Phase II, Final Report; *Fish. & Oceans*, Dartmouth, 88 p.

The second phase of the Beaufort Sea Loran-C evaluation was conducted in April/May 1981 under arctic winter conditions. The tests from the first phase were repeated with improvements and additions. A shift in the time difference readings was observed, due to 1.8 metres of ice on the seawater, the effect of which can be reduced through operational monitoring. Cycle selection was good throughout the coverage area. Calculated conductivities indicated water paths were much worse while land was largely unchanged. Signal strength measurements provided corroboration of these findings. Long range tests at Coppermine showed that a large coverage area can be expected for a chain in this area. Loran-C exceeded expectations, particularly in long range performance, indicating that it is an excellent choice for a Beaufort Sea navigation system. Helicopter and ground tests indicated performance would be adequate on land, sea, and in the air. Standard deviation measurements at some sites indicated that a potential for hydrographic survey applications exists but may require additional transmitted power. Accuracy could be improved through the use of specially designed hydrographic receivers and differential techniques.

1970 KOERNER, R.M., FISHER, D.A., and PARNANDI, M. - 1981
Bore-hole video and photographic cameras; *Annals of Glaciology*, vol. 2, pp. 34-38.

35 mm still and television techniques are shown to be of great value in following changes at the bedrock/ice interface and along borehole walls during closure over one or more years in polar or sub-polar ice caps. We have found no evidence of basal slip over a one year period in a 137 m hole at the top of the flow line on an ice cap in northern Ellesmere Island. However, the bore hole has deformed to an elliptical cross-section near the bed and some pronounced extrusion-like layers have developed within 3 m of the bed in dirty ice in the year since drilling.

1971 MACDONALD, G. - 1981
The use of Microprocessors for Track Control and Data Verification on Hydrographic Surveys in Canada; *Intern. Hydrographic Review*, vol. LVIII, no. 1, pp. 39-53.

In the mid-sixties the Canadian Hydrographic Service began to investigate methods of providing computer assistance to hydrographers that were using conventional data collection techniques. NAVBOX, a microprocessor-controlled survey aid, is a product of these investigations. It provides straight line navigation from a variety of positioning systems, and positions and depths are verified using software filters. First used on board helicopters and tracked vehicles in the Arctic, NAVBOX has been used on regular hydrographic surveys since 1977, and has a number of real and potential survey applications.

1972 VEILLETTE, J.J., and NIXON, F.M. - 1979
Portable drilling equipment for shallow permafrost sampling; *Geol. Surv. Can.*, Paper 79-21, 35 p.

This paper is intended primarily for investigators concerned with shallow (10 m or less) drilling and sampling in frozen soils, and emphasis is on man-portable coring equipment. A description and performance evaluation of the hand-held frost table probe, modified Hoffer probe, standard and modified CRREL core barrels, and motorized equipment for split tube drive sampling, power augering, diamond drilling, water-jet drilling, and trenching are presented. The evaluation criteria include portability, purpose of the investigation program, ground temperature, and texture of the materials.

The compressive strength of frozen soils varies with ground temperature, texture, and water (ice) content. A minimum ground temperature of -5°C is proposed as the practical limit for application of the drive sampling technique in any soil except those with a high clay fraction; a rough latitudinal limit coincident with the -5°C ground isotherm can be used when considering the application of this method in summer. Probing for accurate determination of active layer thickness, while valid for most soils, is not a reliable method in clay-rich soils.

Hand-held power augers equipped with CRREL core barrels are used successfully at any ground temperature below 0°C to core sand, silt, clay, ice, and peat. The operation of power augers, however, is affected by the rotational speed of the coring tool. Field testing indicates that machines of low boring spindle speed (50 rpm) and high torque (350 ft·lb) give consistently satisfactory results.

A light-weight diamond drill, the Winkie GW-15, permits coring of frozen ground consisting of weathered bedrock, sand, silt, and clay in uncased boreholes to depths of 10 m, using a fuel oil drilling fluid cooled naturally below 0°C. Double tube swivel-type core barrels with face discharge diamond coring bits, rotated at speeds of 1500 rpm or more at feed (downward pressure) values of 90 kg, produce excellent cores. Using fresh water as drilling fluid, cores may be obtained in summer in sand, silt, and clay but with significant reduction in core quality. Cores obtained using water in low temperature permafrost in the Arctic Islands are of better quality than those obtained in "warmer" permafrost of upper Mackenzie Valley.

Diamond-drilling rod, core barrel, and bit size specifications conforming to CDDA (Canadian Diamond Drilling Association) standards are summarized and presented in tabulated form.

The limitations inherent in the recirculation of a drilling fluid are identified, and the V. Thompson drill water reclaimer and the hydrocyclone are proposed as alternate means warranting further research to achieve adequate sedimentation of cuttings.

Two all-hydraulic drilling machines, one mounted on an all-terrain vehicle - the ATV drill - and the other a two-component helicopter-portable drill - the JKS 300, are described and evaluated. Performance data of the JKS 300 drill obtained in a wide variety of frozen materials and economical considerations led to the design of the ATV drill, which consists of a 3.7 m mast supporting a hydraulically driven modified Winkie drill and mounted on an all-terrain Argo vehicle. It permits core production comparable to that obtained with heavier truck-mounted drills, if a depth limitation of 10 m is specified. A torque output of 500 ft·lb at the boring spindle is adequate for consistent coring using CRREL core barrels in frozen soils and is proposed as a guideline value for the designing of light-weight augering machines for frozen soils.

1973 VEILLETTE, J., and NIXON, M. - 1980
The development and use of lightweight equipment; *Northern Development*, vol. XII, no. 1, January/February 1980, pp. 21-23.

Scientific research in the North has increased with Arctic gas and oil exploration during the last twenty years. The Terrain Sciences Division of the Geological Survey of Canada has made its own contribution to this scientific endeavour, producing maps describing the distribution of superficial formations in sectors which seemed most likely to be affected by construction activities.

One of the fundamental objectives was to incorporate on these maps an assessment of the physical and geotechnic properties of deposits. From the outset it was clear that serious technical problems would have to be overcome in identifying the presence of ice in the permafrost and in ascertaining its distribution and quantity. The drills which were in common use were more often than not poorly adapted to shallow work (10 m or less). Economic constraints and limitations respecting transport also had to be dealt with, since the latter was often effected by helicopter or light aircraft.

This article outlines the results of a project aimed at improving the techniques and equipment used for drilling in frozen soils and upgrading the efficiency of light equipment of the sort which can be carried in a back-pack or by helicopter. For this purpose, a portable power auger and a unit consisting of a drill mounted on an all-terrain vehicle (ATV drill) were developed.

GENERAL

1974 ANONYMOUS - 1981
How an Irish team went to the Arctic to study solar energy; *Technology Ireland*, News Focus, October 1981, p. 14.

1975 BEARDMORE, R.M., and TAYLOR, J.D. - 1980
Natural Theme Study of Bylot Island/Eclipse Sound, Western Borden Peninsula and Creswell Bay; *Parks Can.*, Internal Report, 149 p.

This study has been conducted, in part, as a follow-up to the Regional Analysis of Natural Region 37 (the Eastern Arctic Lowlands), and in part, to contribute to the determination of Parks Canada's interests in selecting potential National Parks in the Lancaster Sound area.

Three natural areas of Canadian significance (NACS): Creswell Bay; Western Borden Peninsula; and Bylot Island/Eclipse Sound; were identified in the Lancaster Sound Area as a result of the preliminary analysis of natural themes conducted during the Region 37 study. Prince Leopold Island/Cape Clarence, having been identified as a natural site of Canadian significance (NSCS), is a potential Canadian Landmark and is not considered in this analysis.

In order to determine which of the NACS would rank as the most promising candidate as a future national park, it was imperative to conduct a more detailed assessment of the three areas. A great deal of new information, either published or unpublished, has been generated since the previous study was conducted, and it is hoped that this new information and the following natural theme analysis will provide a sound basis for selecting a new National Park in the Region 37/Lancaster Sound area.

The information provided in this report may be used as one component of the Parks Canada input to the "Green Paper" being prepared by the Northern Affairs Program, Department of Indian and Northern Affairs, which is attempting to assemble all bio-physical and socio-economic information of the Lancaster Sound area as an initial step in formulating a regional plan.

1976 BIEFER, G.J. - 1980
Survey of atmospheric corrosivity in the Canadian Arctic; *Can. Centre for Min. & Energy Tech.*, internal report MRP/PMRL 80-13 (TR), 28 p.

The first atmospheric corrosivity survey of the Canadian Arctic and sub-Arctic was performed, using mild steel wire-on-nylon bolt specimens, exposed for a period of one year. For purposes of comparison, specimens were also exposed at a number of points in Southern Canada.

Average rates of penetration by corrosion as low as 2-5 μm/a were recorded at ten inland sites on the mainland of the western Arctic and in the north-west Arctic Islands. However, at seven other northern sites, usually within 1 km of the sea, corrosion rates of 21-34 μm/a were experienced, comparable to the rates of

22-30 μm/a recorded at seven points in southern Quebec and Ontario. The unexpectedly high corrosion rates in the north were tentatively attributed to localized concentrations of atmospheric chloride; they indicate that the same kinds of anti-corrosion measures will sometimes be needed for metallic materials in Arctic environments as are required in southern Canada.

1977 BIEFER, G.J. - 1980
Survey of atmospheric corrosivity in the Canadian Arctic: supplementary results; *Can. Centre for Min. & Energy Tech.*, internal report MRP/PMRL 80-71 (TR), 7 p.

Mild steel wire on nylon bolt atmospheric corrosivity specimens, exposed in Canadian Arctic locations for two years (1978-80), provided results compatible with those obtained previously, using similar specimens exposed for one year (1978-79).

Average rates of penetration by corrosion were from 2-4 μm/a at five sites in the Arctic Islands and on the northwest mainland, removed from the coast. A relatively high rate of 22 μm/a was observed at Cape Parry, at a site 1 km from the Beaufort Sea.

1978 BIEFER, G.J. - 1982
Arctic Corrosion; *GEOS*, Energy, Mines & Res., vol. 11, no. 1, pp. 18-21.

Steel corrosion rates decrease from south to north and east to west. Higher rates in the Arctic were almost always close to the sea.

1979 BOWERMAN, S. - 1981
Beneath a frozen sea - Diving the North Pole; *Oceans*, no. 3, pp. 4-7.

1980 BRUEMMER, F. - 1980
'Herschel: The Big Town'; *The Beaver*, Winter 1980, pp. 26-35.

TODAY HERSCHEL ISLAND in summer is a lovely, peaceful place. It is a small island, roughly eight miles long and five miles wide, rising gently to a height of nearly 600 feet. Only one family now lives on Herschel. It is an island of rolling meadows, of flowers and of birds, quiet and serene. And it is an island of graves, mementos of its strange and often violent history.

1981 DYSON, J. - 1979
The Hot Arctic; published by Heinemann, London, England, 43421960 6, 290 p.

The contents of the book cover: the look and the feel of the Arctic; the daily life of the Eskimos and the White settlers; the search for energy resources and the dangers of bringing oil to the surface; environmental difficulties of developing energy resources; the survival of the wildlife; world power - confrontation of the super-powers across uncharted boundaries; the survival of the Eskimos in the modern world.

1982 DYSON, J. - 1979
Mysteries of the North Water; *Reader's Digest*, November 1979, pp. 102-106.

1983 FUSHIMI, H., UEMURA, N., HIGUCHI, K., and IKEGAMI, K. - 1979
Scientific Studies Made during Solo Dogsled Journeys to the North Pole and Across Greenland; *SANGAKU*, J. Japanese Alpine Club, Water Res. Inst., Nagoya Univ., 24 p.

On March 5, 1978, Naomi Uemura left the Aurora Base Camp on Ellesmere Island and reached the North Pole on April 29. He then set out from Cape Morris Jesup, the north end of Greenland on May 10 and completed the first longitudinal crossing, arriving at the southern tip of Greenland on August 22, 1978. Both were solo journeys.

Since his route from north to south on the Greenland ice sheet had never been trodden by human beings before, Uemura's observations on snow, ice and glacier conditions, and samplings are significant.

1865 GERACI, J.R., and SMITH, T.G. - 1979
Vitamin C in the Diet of Inuit Hunters From Holman, Northwest Territories; *Arctic*, vol. 32, no. 2, pp. 135-139.

1984 HOBSON. G.D., and VOYCE, J. - 1977
Titles and Abstracts of Scientific Papers Supported by PCSP; *Polar Cont. Shelf Proj.*, Dept. Energy, Mines & Resources, vol. 3, Cat. No. M78-5/1978, 97 p.

1985 HOBSON, G.D., and VOYCE, J. - 1980
Titles and Abstracts of Scientific Papers Supported by PCS^{p}; *Polar Cont. Shelf Proj.*, Dept. Energy, Mines & Resources; vol. 4, Cat. No. M78-5/4-1980E, 89 p.

1986 LEHN, W.H., and EL-ARINI, M.B. - 1978
Computer-graphics analysis of atmospheric refraction; *APPLIED OPTICS*, vol. 17, pp. 3146-3151.

Interactive computer graphics is applied to the transmission of visual images through the lower atmosphere. The required input data to the computer consist of an atmospheric temperature profile and light-pen sketches of three objects at various distances from the observer. A transfer characteristic, computed from a bundle of rays leaving the observer, maps each object's actual location into a corresponding image. The three images, and the horizon line, are then simultaneously displayed on the graphics terminal, thus generating a pictoral version of what the observer would see. This program provides an essential aid to the study of atmospheric refraction.

1987 LEHN, W.H. - 1979
The Novaya Zemlya effect: An arctic mirage; *J. Opt. Soc. Am.*, vol. 69, no. 5, pp. 776-780.

The arctic mirage is an atmospheric refraction phenomenon caused by a temperature inversion in the lower atmosphere. It is classified into three basic types, two of which (*hillingar* and *hafgerdingar* effects) occur fairly frequently. The third is the Novaya Zemlya effect reported by polar explorers on several occasions as an anomalous sunrise during the polar winter, when the position of the sun was below the horizon. The Novaya Zemlya effect consists of the trapping of light rays beneath a thermocline of large horizontal extent. Within the thermocline layers, the coefficient of refraction must exceed 1, while above and below it the coefficient must be less than 1. Then certain upward rays repeatedly bounce back from the thermocline and are transmitted for long distances around the earth's curvature. The anomalous sunrise is a special case of this generalized definition. The properties of the Novaya Zemlya effect, analyzed using a laterally uniform stratified-atmosphere model, agree with those reported by polar expeditions. A narrow strip or window appears near the horizon, with or without an image of the sun in the window. An observation sketched by Liljequist in Antarctica is reconstructed to demonstrate the model's accuracy.

1988 LEHN, W.H. - 1979
Atmospheric Refraction and Lake Monsters; *Science*, vol. 205, no. 4402, pp. 183-185.

A survey of reported sightings of lake monster phenomena suggests that many of them may be attributable to atmospheric image distortion. The existence of the necessary conditions (surface temperature inversion and hence strong atmospheric refraction) can be inferred from most of the reports. Under such conditions familiar objects can easily take on unrecognizable form. Two photographs demonstrate the extent of the distortion that can occur.

1989 LEHN, W.H., and SCHROEDER, I.I. - 1979
Polar Mirages as Aids to Norse Navigation; *Polarforschung*, vol. 49, no. 2, pp. 173-187.

The possibility is examined that the Norse may have gleaned information from polar mirages for their westward expansion across the North Atlantic. Two types of superior mirages, the *hillingar* and the Novaya Zemlya effects, are explained briefly. Examples reported by early explorers are used to familiarise the reader with the effects and to illustrate both their informative and confusing natures. Specifically optical theory is applied in an attempt to establish the Gunnbjorn Skerries as images of the Greenland coast, transmitted by mirage across the Denmark Strait. This hypothesis is supported by an examination of the available historical evidence.

1989 LEHN, W.H., and SCHROEDER, I. - 1980
Atmospheric optics and Norse navigational techniques: an analysis; *Univ. Man.*, TR80-1, 1980 0116, 40 p.

1990 LEHN, W.H. - 1980
On the sighting of distant unidentified objects; *J. Atmospheric and Terrestrial Physics*, vol. 42, pp. 471-475.

Reported sightings of mysterious bright objects are used to illustrate a general principle that applies to the observation of small distant objects: no image of such objects can be considered accurate unless an analysis demonstrates that no refractive distortion is present. It is proposed that the UFO sightings off New Zealand in January 1979 are due to images transmitted by the Novaya Zemlya effect, an anomalous atmospheric refraction. The extent of image distortion that can occur is illustrated by two photographs.

1991 MacINNIS, J. - 1980/81
Joe MacInnis explores the Arctic depths; *Can. Geographic*, Dec 1980/Jan 1981, pp. 18-26.

1992 SASKATOON *Star-Phoenix* - 1980
Modern Transportation Assists Arctic Scientific Work; *Musk-ox*, vol. 27, pp. 90-91.

The flight heralded the beginning of an active season of scientific research co-ordinated by the Polar Continental Shelf Project, an arm of the federal energy department.

1896 SMITH, T.G. - 1978
Travelling the Arctic by snowmobile; *Can. Geographical J.*, February/March 1978, pp. 60-65.

1993 SMITH, T.G. - 1979/80
How Inuit trapper-hunters make ends meet; *Can. Geographic*, Dec 1979/Jan 1980, pp. 56-61.

1994 STICH, H.F., and DUNN, B.P. - 1980
The Carcinogenic Load of the Environment: Benzo (a)Pyrene in Sediments of Arctic Waters; *Arctic*, vol. 33, no. 4, pp. 807-814.

Baseline levels of the chemical carcinogen benzo(a)pyrene were measured in arctic sediments. Levels were highest in samples from the Mackenzie River delta and adjacent areas of the Beaufort Sea. The distribution of carcinogen did not correspond to the location of inhabited areas - a natural rather than a man-made source for polycyclic aromatic hydrocarbons in arctic sediments is indicated.

1912 STIRLING, I., WALLACE, R.R., and GLAZIER, G.T. - 1979
An environmental research and management strategy for the Eastern Arctic region: a discussion; *Northern Perspectives*, vol. VII, no. 6, pp. 4-5 and 8-9.

1927 ZOLTAI, S.C., KARASIUK, D.J., and SCOTTER, G.W. - 1980
A natural resource survey of the Thomsen River Area, Banks Island, Northwest Territories; *Parks Can.*, internal report, 153 p.

1995 ANONYMOUS - 1979
Canadian study to unlock secrets of Arctic seafloor; *Can. Mining J.*, September 1979, pp. 29-32.

1996 ANONYMOUS - 1980
LOREX; *Canada Today/d'aujourd'hui*; vol. 11, no. 7, p. 13.

In March 1979, the Department of Energy, Mines and Resources began a $1.2 million interdisciplinary project to study the geologic nature and origin of the Lomonosov Ridge, a mountain range on the floor of the Arctic Ocean. The team of forty-two scientists and technicians also included participants from the Department of Fisheries and Oceans, and from McGill, Dalhousie and the University of Washington. It was called LOREX and was the largest scientific expedition ever conducted that far north.

1997 BARRIE, W.B., BORNHOLD, B.D., HODGSON, D.A., JUBB, R.G., McLAREN, P., and TAYLOR, R.B. - 1979
Coastal reconnaissance for marine terminal planning in the High Arctic, District of Franklin; *Geol. Surv. Can.*, Dept. Energy, Mines and Resources, Open File No. 633.

1998 BARSCH, D., and KING, L. - 1979
Die Heidelberg Ellesmere Island Expedition; *Marburger Geographische Schriften*, Proc. Kanada Naturraum und Entwicklungspotential, Eds. C. Schott and A. Pletsch, Marburg/Lahn, vol. 79, pp. 45-56.

Seven members of the Department of Geography, University of Heidelberg, and the Department of Geodesy, University of Karlsruhe, Germany, stayed from June 20 to August 8, 1978 in the Neil Peninsula/Oobloyah Bay area, 125 km north-northeast of Eureka, Ellesmere Island for geomorphological and related field studies.

1999 BLAKE, Jr., W. - 1979
Age determinations on marine and terrestrial materials of Holocene Age, Southern Ellesmere Island, Arctic Archipelago; *in* Current Research, Part C; Geol. Surv. Can., Paper 79-1C, pp. 105-109.

Marine mollusc shells frequently have been used for radiocarbon age determinations because they are the most abundant type of material available along many of the world's coasts. Canada is no exception in this regard, and the earliest age determinations on shells from the Canadian Arctic Archipelago and adjacent northwestern Greenland were carried out more than two decades ago by laboratories at Lamont Geological Observatory, New York and by the U.S. Geological Survey, Washington, D.C.. At the same time that marine shells were being widely used for dating, doubts were voiced on numerous occasions as to their validity. This note re-emphasizes some of the results obtained by comparative dating of terrestrial and marine materials at one locality in southern Ellesmere Island and presents new data from a second locality.

2000 BLAKE, Jr., W. - 1981
Lake Sediment Coring along Smith Sound, Ellesmere Island and Greenland; *in* Current Research, Part A, Geol. Surv. Can., Paper 81-1A, pp. 191-200.

During the 1979 and 1980 field seasons, cores of bottom sediments have been recovered from six lakes on the Ellesmere Island side of Smith Sound and from three lakes in Inglefield Land, northwestern Greenland. Radiocarbon age determinations on basal organic material from a lake at 390 m on Pim Island and from a lake at 295 m above Ekblaw Glacier, innermost Baird Inlet, indicate that both areas were free of glacier ice by 9000 years ago. The basal moss-rich sediment from a pond at 300 m in a moraine above Baird Inlet is slightly younger, perhaps because dead ice may have persisted at that locality.

2001 BLAKE, Jr., W. - 1981
Lake Sediments from Baird Inlet, east-central Ellesmere Island, Arctic Canada; radiocarbon and pollen data; *Abstract in* Proc. Third Inter. Sym. Paleolimnology, Joensuu, Finland, September 1981, p. 35.

A 56-cm long core covering ∿9000 yrs. was obtained from an unnamed lake (78°29.5'N, 76° 46.8'W) at 295 m elevation, innermost Baird Inlet. The lake is ca. 250 by 150 m and occupies a deep, closed basin excavated in a rock "island" surrounded by valley glaciers. The bedrock is granulite gneiss and the local vegetation is relatively lush, with areas of *Empetrum nigrum - Vaccinium uliginosum - Cassiope tetragona* heath on south-facing slopes above the lake. Cores were taken from near the lake centre through 14.6 m of water under 101 cm of ice. Basal sandy-silt is overlain by 51 cm of laminated silty gyttja and fine detritus gyttja grading upwards into loose algal gyttja. Three ^{14}C age determinations are available from Core 3:

20-25 cm 4080 ± 210 yrs (GSC-3192)
$\delta^{13}C$ = -36.6‰.

30-35 cm 6780 ± 220 yrs (GSC-3184)
$\delta^{13}C$ = -37.2‰

46-51 cm 8970 ± 160 yrs (GSC-3051)
$\delta^{13}C$ = -31.2‰

Rates of sedimentation vary from 0.07 to 0.04 mm/yr. Pollen concentration in samples analysed at 2.5 cm intervals varies from 1500-2000 per cm^3 in the lower part of the core to 100-200 in the upper part; calculated pollen influx is between 17 and 0.8 grains per cm^2 per yr. The basic total of ca. 100 grains/sample includes exotic/derived pollen (tree pollen and indeterminables) and excludes spores. The amount of exotic/derived pollen is low (2-10%) through most of the core, with some rise towards the top. The basal sandy-silt is devoid of local pollen but does contain some obviously derived pollen, mainly degraded betuloid and coniferous types. Four local pollen zones reflect an early pioneer phase (grass-sedge-*Oxyria/Rumex*) in the lowermost organic sediment, followed by a spread of *Salix* and then, some 7000 to 6560 years ago, a rise in Ericales. The topmost zone shows some increase in indicators of bare ground and fell-field vegetation

(*Saxifraga*, Ranunculaceae, Caryophyllaceae, *Dryas*), hence deterioration of local conditions during the last 4000 years.

2002 BLAKE, Jr., W. - 1981
Neoglacial fluctuations of glaciers, southeastern Ellesmere Island, Canadian Arctic Archipelago; *Geogr. Ann.*, vol. 63A, nos. 3-4, pp. 201-218.

Two new series of radiocarbon age determinations form the basis for this paper. The first series shows that both the outer east coast of Ellesmere Island (north to latitude 78°36') and much of Makinson Inlet were free of glacier ice prior to 9000 radiocarbon years ago (dates uncorrected for the apparent age of sea water). However, on the basis of the available data the head of the north arm of Makinson Inlet, north of the present site of Split Lake, was not invaded by a marine fauna until about 2000 years later, presumably because of the persistence of glacier ice in this trough.

The second series of age determinations relates to fluctuations of outlet glaciers during Holocene time. Dates of 5180±260 years (GSC-2909) and 2590±150 years (GSC-3191) for the bottom and top, respectively, of a massive peat deposit bracket a period during which outlet glacier 7A-45, north of the head of Makinson Inlet, was smaller than it is at present. Data from several sites suggest an advance of glaciers about 1000 years ago, and a second advance, during the last 100 years or so, is recorded at the margins of a number of glaciers draining the ice caps in central and southeastern Ellesmere Island.

2003 BLASCO, S.M., BORNHOLD, B.D., and LEWIS, C.F.M. - 1979
Preliminary results of surficial geology and geomorphology studies of the Lomonosov Ridge, Central Arctic Basin; *in* Current Research, Part C, Geol. Surv. Can., Paper 79-1C, pp. 73-83.

Bathymetric subbottom and shallow seismic reflection profiling, sediment sampling, seabed photography and water column temperature and sound velocity profiling, as well as surface plankton tows, were conducted in April and May 1979 from the ice station LOREX as it drifted over the Lomonosov Ridge close to the North Geographic Pole. These seabed geologic studies in conjunction with other scientific programs, were undertaken to delineate the physical nature and origin of this little-known Arctic submarine feature. The Lomonosov Ridge has a relief of 2800 m and a width of 88 km along the drift path. Asymmetrical in cross-section, the Amerasian flank has slopes as steep as 12 whereas the Eurasian flank slopes are less than 7°. The ridge appears to consist of en echelon fault blocks that give the crest an irregular morphology. A thin veneer of unconsolidated sediments, primarily deposited on the fault block tops, is presently undergoing erosion by current action. These sediments were probably deposited prior to the assumed separation of the ridge from the Barents Continental Shelf. The presence of dinoflagellate *Luxadinium propalulum* in the surface material recovered from the ridge crest suggests that this separation was initiated no earlier than mid-Cretaceous. Observed thermal alteration of this species could have occurred during the early stages of spreading along the Nansen-Gakkel rift.

2004 BORNHOLD, B.D., and BONARDI, M. - 1979
Magnetic spherules in Arctic Ocean sediments; *Can. J. Earth Sci.*, vol. 16, no. 9, pp. 1778-1788.

Five types of spherule were found in Quaternary sediments from the Canada Abyssal Plain. They include type A spherules composed of magnetite and hematite surrounding metallic iron cores, exsolution blebs, or veinlets (Ni, Fe, Co); type B, of nearly pure homogeneous magnetite; type C, displaying intergrowths of magnetite and hematite and containing minor Ti(<1%); type D, composed predominantly of magnetite with significant amounts of Ti(up to 4.8%); and type E, consisting of ilmenite and rutile with Ti, Si, Fe, Mn, Al, K, and Mg as major elements and Cr, Ca, and Na as minor elements. Ni and Co were detected only in a small metallic veinlet (with Fe) surrounded by magnetite containing significant amounts of Ti.

Three possible sources are considered: industrial, volcanic, and extraterrestrial. Industrial input is unlikely in view of the great distances to possible sources and the relatively large size of the particles. The high Ti content of most of the spherules suggests a volcanic origin. The five type B spherules are the only possible candidates for a cosmic origin.

2005 BRAND, U., and VEIZER, J. - 1979
Diagenesis of a multicomponent Paleozoic carbonate system; *Abstract in* Program of Abstracts, vol. 4, MAC Mtg., Quebec, May 23-25, 1979, p. 71.

Theoretical consideration of diagenetic stabilization by meteoric waters suggests that it leads to a decrease in Sr, Na, O^{18}/O^{16}, (C^{13}/C^{12}) and increase in Mn, Fe in progressively altered carbonates. The rate at which particular internal components approach open system equilibrium is dictated by their mineralogical stability. The path of this equilibrium for each fossil group can be followed across facies on Sr-Mn covariance diagrams.

Chemical criteria, combined with textural studies, show that the Burlington Limestone (Mississippian), was completely equilibrated with meteoric waters, while the Read Bay Formation (Silurian) was less affected. As a consequence, in the Burlington, the rock matrix (eg. biosparite), the enclosed crinoids (originally high-Mg calcite) and to some degree the rugosas (originally low-Mg (?) calcite) are chemically identical. The crinoid ossicles have an average Sr content of 120 ppm, rugose corals 180 ppm and the enclosing biosparite 120 ppm. In contrast the internal components in the Read Bay have specific chemistry, with 210 ppm Sr for crinoids, 800 ppm for rugosas and 360 ppm for their enclosing micritic matrix.

Evaluation of published data shows that in most cases diagenetic equilibration ceases while some internal differences in chemical composition are still preserved. This supports the concept of the bulk solution disequilibrium diagenetic model. If so, such criteria could serve as a potential tool for evaluation of the degree of diagenesis and for estimating the original composition of the different stabilized carbonate phases.

2006 BRAND, U., and VEIZER, J. - 1980
Chemical diagenesis of a multicomponent carbonate system - 1: trace elements; *J. Sedimentary Petrology*, vol. 50, no. 4, pp. 1219-1236.

Theoretical considerations (i.e., partition coefficients, water/rock ratio, chemistry of interstitial meteoric water) of elemental behaviour during diagenetic stabilization with meteoric waters suggests that it leads to a decrease in strontium, sodium, and possibly magnesium and an increase in manganese, iron, and zinc in progressively altered carbonates.

Such elemental behaviour is exhibited by the different carbonate components of the Mississippian Burlington Limestone of Iowa and Missouri and the Silurian Read Bay Formation of Arctic Canada. In the Burlington Limestone the rock matrix (e.g. biosparite), the enclosed crinoids, and to some degree the rugose corals are chemically similar. The crinoid ossicles have average strontium content of 160 ppm, rugose corals 180 ppm, and the enclosing biosparite 120 ppm. In contrast, in the Read Bay Formation each of the above mentioned components has a specific chemistry, with 210 ppm strontium for crinoids, 780 ppm for rugose corals, and 360 ppm for their enclosing micrite matrix. These chemical trends are accompanied by textural changes of the host carbonate sediments. In the Burlington Limestone this involves the presence of depositional sparite, whereas in the Read Bay Formation this increase in textural maturity involves the transition from micrite to microspar to minor pseudospar and sparite.

The combination of these textural trends with the elemental patterns shows that the degree with which a particular carbonate component approaches either the open system or the partly closed system equilibrium is dictated by its respective mineralogical stability and the water/rock ratio. While the results show that the carbonate assemblage may act as a completely open diagenetic system (e.g. Burlington Limestone), available data for the majority of studied sequences (e.g. Read Bay Formation) suggest that diagenetic equilibration ceases while some original depositional differences in chemical composition are still preserved. This implies that diagenetic stabilization proceeds through partly closed reaction zones on solid-liquid interfaces. Transfer of the chemical and textural information from the dissolving phase (original sedimentary carbonate particle) to the precipitating phase (diagenetic carbonate component) proceeds via a *Messenger Film* water in the reaction zone, which is in disequilibrium with the meteoric bulk aquifer water.

Thus the chemical composition of carbonate components of ancient limestones may serve as a potential tool for evaluating the degree of diagenesis and for deducing the original mineralogy of the different stabilized carbonate phases. Application of this trace element model suggests that Paleozoic crinoids were composed originally of metastable high-magnesium calcite, rugose corals were composed originally of stable low-magnesium calcite or high-magnesium calcite with low Mg^{2+} content, and micrite was originally aragonite lime mud.

2007 BRAND, U. - 1981
Geochemical analysis of the Ordovician Thumb Mountain Formation, Cornwallis lead-zinc District, Arctic Canada; *Abstract in* CSPG Third Inter. Sym. Arctic Geology, June 28-July 1, 1981, Calgary, Alta. p. 30.

Sodium and strontium data support paleontological and sedimentological interpretations that the lime muds (110 ppm, Na^+; .63, 1000 Sr/Ca) of the limestone lithofacies of the Thumb Mountain Formation on Cornwallis and Little Cornwallis islands were deposited on a shelf-lagoon. The chemical data also support the interpretation that the penecontemporaneous dolomite (310 ppm, Na^+; .71, 1000 Sr/Ca) of the dolomite lithofacies of the formation formed by the early-diagenetic replacement of unconsolidated lime muds in a shallow shoal environment.

The diagenetic stabilization of the original aragonite lime muds and penecontemporaneous dolomite of the formation took place in a phreatic meteoric environment. This process was controlled in part by the thermodynamic stability of the original carbonate phase, the chemistry of the aquifer water, and the water/rock ratio. A low water/rock ratio caused a chemical disequilibrium state to exist between the water of the aquifer system and that of the diagenetic microenvironment. Stabilization lowered the original chemical composition of the sedimentary carbonate components. However, chemical gradients preserved in the limestones (70 ppm, Mn^{2+}; 240 ppm, Sr^{2+}; -6.1 $^{0}/oo$, $d^{18}o$ (PDB); -0.4 $^{0}/oo$, $d^{13}c$ (PDB)) and penecontemporaneous dolomite (60 ppm, Mn^{2+}; 170 ppm, Sr^{2+}; -3.8 $^{0}/oo$, $d^{18}o$; -1.0 $^{0}/oo$, $d^{13}c$) are characteristic of the original precursor lime muds.

Hydrothermal dolomite is found commonly in close association with lead and zinc mineralization in the formation. The chemical composition of the hydrothermal dolomite at Polaris (40 ppm, Sr^{2+}; 530 ppm, Mn^{2+}; -8.8 $^{0}/oo$, $d^{18}o$; - .0.4 $^{0}/oo$, $d^{13}c$) is slightly different from that at Abbott River West (30 ppm, Sr^{2+}; 630 ppm, Mn^{2+}; -9.5 $^{0}/oo$, $d^{18}o$; -1.8 $^{0}/oo$, $d^{13}c$). This difference in chemistry of the hydrothermal dolomite relates to differences in temperature, chemical composition or meteoric component of the dolomitizing-mineralizing fluid(s) at the two localities.

2008 BRAND, U., and VEIZER, J. - 1981
Chemical diagenesis of a multicomponent carbonate system - 2: stable isotopes; *J. Sedimentary Petrology*, vol. 51, no. 3, pp. 0987-0997.

This study examines the oxygen and carbon isotopic distribution in the brachiopods, crinoids, rugose corals, and matrix/cement from the Mississippian Burlington Limestone (Iowa and Missouri) and the Silurian Read Bay Formation (Arctic Canada). The isotopic data can be reconciled with textural and trace element observations only if the ^{18}O content of ancient oceans differed from that of the present oceans. This postulated secular variation in the ^{18}O content of seawater requires a separate evaluation of the Mississippian and Silurian carbonate components. Examination of the ^{18}O content of the *least-altered* low-Mg calcite fossil components of the two formations suggests that the $\delta^{18}O$ of Mississippian seawater was, on average, about 1.5 $^{0}/oo$ lighter, and that of Silurian seawater was about 5.5 $^{0}/oo$ lighter than the $\delta^{18}O$ of present day ocean water.

The average diagenetic shift in $\delta^{18}O$ for the Read Bay Formation, which stabilized in a partly closed diagenetic phreatic meteoric system, is about - 1 $^{0}/oo$ for the original low-Mg calcite and about - 2 $^{0}/oo$ for the original high-Mg calcite and aragonite components. Conversely, for the Burlington Limestone, which stabilized in an open diagenetic phreatic meteoric system, the average diagenetic shift in $\delta^{18}O$ is about - 3 $^{0}/oo$ for the original low-Mg calcite and about -4 $^{0}/oo$ for the original high-Mg calcite components.

The $\delta^{13}C$ values of the originally low-Mg calcite (or high-Mg calcite with less than 7 mole % $MgCO_3$) brachiopods and rugose corals, the originally high-Mg calcite crinoids, and the originally aragonite lime mud of the Burlington Limestone and Read Bay Formation are bimodally distributed. This bimodal $\delta^{13}C$ distribution is independent of geologic age, inferred original mineralogy of the component, degree of diagenetic alteration, and the type of diagenetic meteoric system, with components from both the Read Bay Formation and Burlington Limestone contributing to both ^{13}C groups. The mode of the light - ^{13}C group is +0.25 $^{0}/oo$ and for the heavy - ^{13}C group it is +3.25 $^{0}/oo$ (PDB). Both ^{13}C groups also show a decrease in ^{13}C of about 1 $^{0}/oo$ with increasing diagenetic alteration (stabilization).

2009 CAMPBELL, F.H.A. - 1981
Stratigraphy and tectono-depositional relationships of the Proterozoic rocks of the Hadley Bay Area, Northern Victoria Island, District of Franklin; *in* Current Research, Part A, Geol. Surv. Can., Paper 81-1A, pp. 15-22.

Proterozoic sedimentation in the northernmost part of the Kilohigok Basin commenced with deposition of shallow marine to nonmarine quartzose clastics of the Hadley Formation in depressions on dissected Archean(?) basement. Fine grained sandstones then accumulated on a periodically-exposed shelf. As terrigenous sedimentation diminished, clastic and stromatolitic carbonates spread across the slowly subsiding basin. Intertidal to shallow subtidal bioherms developed in the northeastern part of the area, while calcareous siltstones were deposited in the southwest. Renewed uplift in the source areas supplied fine grained sands and silts to the again periodically emergent shelf, and their deposition continued until the end of Hadley Formation sedimentation.

Syndepositional faults and regional tilting supplied large volumes of coarse debris to northerly- and northwesterly-flowing fluvial systems. Unsorted conglomerates were deposited close to active faults, while better-sorted congomerates and trough crossbedded sands were deposited in the more distal regions.

Subsequent subsidence of the entire area, coupled with reactivated uplift in the southerly and easterly source areas, caused marine sands to spread over the shallow shelf. These were dispersed by large sand waves which produced the very large scale trough crossbeds characteristic of this unit.

Gentle tilting and regional peneplanation followed, and led to the deposition of fine reddish sands, muds, and coarse white quartzites of the Glenelg(?) Formation.

Paleocurrent and facies analyses of the Hadley Formation, together with data from the Eastern Platform of the Kilohigok Basin to the south, indicate that an east-west trending aulacogen off the Wopmay Orogen was present in the Coronation Gulf area during deposition of the sediments of the Kilohigok Basin.

2010 CHANDLER, F.W., CHARBONNEAU, B.W., CIESIELSKI, A., MAURICE, Y.T., and WHITE, S. - 1980
Geological studies of the Late Precambrian supracrustal rocks and underlying granitic basement, Fury and Hecla Strait Area, Baffin Island, District of Franklin; *in* Current Research, Part A, Geol. Surv. Can., Paper 80-1A, pp. 125-132.

For about 150 km along the north shore of Fury and Hecla Strait, and extending up to 50 km inland lies a belt of mainly clastic sedimentary rocks. This unmetamorphosed Helikian and/or Hadrynian sequence, about 6000 m thick, is divided into five conformable units, described in ascending stratigraphic order. The lowest unit consists of red sandstone and shale with minor quartz-pebble conglomerate and stromatolitic dolomite passing up into white quartzite. The second unit consists of a coarsening-upward sequence of red shale and sandstone with black shale and stromatolitic dolomite at its base. A westward-thinning pink quartzite unit is followed by a varicoloured sandstone-shale unit, transitional into a black shale unit. Both alluvial and marine depositional environments are represented in the sediments, and paleocurrents flowed broadly westward. Deformation is limited to faulting and gentle southward tilting.

Lying nonconformably beneath the sediments are granitic and gneissic rocks of Archean and/or Aphebian age. Mapping, concentrated about two large radiometric anomalies situated in the east and west of the area, showed them to be broadly coincident with weakly-deformed pink biotitehornblende granite, cut by granitic pegmatite. The granite, present as a batholith in the east, is also present as smaller bodies in the west. The eastern granite is margined by pre- to syntectonic porphyritic monzonite(?) that cuts widespread surrounding mesocratic tonalitic gneiss. A thick sequence of orthogneiss and paragneiss, partly of sedimentary origin in the western area is varied in composition and fabric. Deformation in both areas is intense except in the case of the granite and pegmatite. Geochronological and paleomagnetic studies of these rocks are in progress.

Ground radiometric and geochemical analyses show that the two previously discovered large uranium-thorium radiometric anomalies are caused by underlying pink basement granite. Whereas surrounding gneisses and late Precambrian supracrustal rocks give a weak radioactive response. Proximity of the anomalies to an Early Helikian(?) unconformity is significant for mining exploration. A core zone and some other locations within the eastern granite batholith are considerably more radioactive than the bulk of the body. Uranium and thorium concentrations are also present in pegmatite bodies, filling shear zones in the basement near and within the Proterozoic sediments and associated with quartz-pebble conglomerate in the sediments.

2011 CHANDLER, F.W., and STEVENS, R.D. - 1981. Potassium-Argon Age of the Late Proterozoic Fury and Hecla Formation, Northwest Baffin Island, District of Franklin; *in* Current Research, Part A, Geol. Surv. Can., Paper 81-1A, pp. 37-40.

About 6000 m of Proterozoic clastic sediments overlie basement of the Churchill Province in northern Baffin Island. Mafic volcanic rocks near the base of the lower, quartzite-rich Fury and Hecla Formation yield ages of 1089, 1117 and 1121 Ma. A sill cutting the overlying black, shale-rich Autridge Formation gives ages of 716 and 746 Ma. Two mafic dykes cutting both formations, one probably cutting the sill, have ages of 631 and 643 Ma.

Validity of these ages is enhanced by their being reasonably close to the Mackenzie and Franklin igneous events. The dates indicate that sedimentation of the two formations commenced in the Neohelikian sub-era and may have extended into the middle of the Hadrynian era. Similarity between this succession and the Proterozoic sedimentary succession on Borden Peninsula to the north suggests that the latter succession might be of similar age.

2012 COSTASCHUK, S.M. - 1980
Heavy mineral analysis of southern Beaufort Sea Sediments; *in* Current Research, Part A, Geol. Surv. Can., Paper 80-1A, pp. 241-252.

Fluvial erosion and transportation, shoreline retreat, denudation of relict arenaceous sediments, and ice-related phenomena are processes presently causing the influx of coarser grained sediments into the southern Beaufort Sea coastal and shelf sediments. The fine terrigenous sands are poorly sorted mineralogically and texturally. Limited authigenic mineralization is occurring on the seafloor at present. Heavy mineral analyses that were carried out on southern Beaufort Sea sands (0.06-0.25 mm fraction) indicate that the sands are derived from preexisting sedimentary beds as well as from igneous and metamorphic rocks.

Ultrastable and metastable transparent minerals form the bulk of the heavy mineral residue. Zircon, tourmaline, and rutile constitute the former and least abundant group, and clinopyroxene, clinoamphibole, garnet, staurolite, kyanite, sillimanite, andalusite, mica, and heavy carbonates are the most commonly encountered minerals of the latter group. A variety of opaque iron and titanium oxides are also present. The minerals and mineraloids recognized under reflected light are magnetite, ilmenite, leucoxene, geothite, hematite, and pyrite.

Two distinct heavy mineral provinces are recognized in the southern Beaufort Sea: (1) an area characterized by clinopyroxene-clinoamphibole lies to the west of Mackenzie Bay and (2) one with clinopyroxene-clinoamphibole-garnet lies to the east. West of Mackenzie Delta the source of sediment is the Cordillera; east of the delta much of the coarse sediment is believed to have originated from both the Canadian Shield and the sedimentary rocks of the northern Interior Plains.

1936 CWYNAR, L.C., and RITCHIE, J.C. - 1980
Arctic Steppe-Tundra: A Yukon Perspective; *Science*, vol. 208, pp. 1375-1377.

2013 DIXON, O.A., NARBONNE, G.M., and JONES, B. - 1981
Event Correlation in Upper Silurian Rocks of Somerset Island, Canadian Arctic; *in* Bull. American Assoc. Petroleum Geologists, vol. 65, pp. 303-311.

Recurring sedimentary events can sometimes be used for time correlation in sequences where biostratigraphic control is insufficient. On Somerset Island in the Canadian Arctic, the Upper Silurian Leopold Formation, a thick heterogeneous, sparsely fossiliferous carbonate sequence, largely of intertidal origin, displays broad fluctuations in siliciclastic content. The peaks of detrital content can be correlated widely and are considered to be time-equivalent. A field correlation using lithologic markers accentuated by weathering relief agrees with the proposed event correlation. Preliminary studies of fossil ostracoderms suggest that a complementary faunal succession is also present. According to the event correlation, previously defined lithostratigraphic boundaries are diachronous, some markedly so.

2014 DYKE, A.S. - 1980
Redated Holocene whale bones from Somerset Island, District of Franklin; *in* Current Research, Scientific and Technical Notes, Part B; Geol. Surv. Can., Paper 80-1B, pp. 269-270.

Dyke (1979) presented Holocene emergence curves for Somerset Island based on 36 radiocarbon dates on marine shells, whale and walrus bones, and driftwood. Of the thirteen whale bone samples that were dated, three were by far too young - that is, they plotted above the emergence curves. All three specimens had lichen and moss growing on them at time of collection, and this contamination was suspected as the cause of the anomalously young age determinations. These samples have since been redated and the results are briefly discussed in this note.

2015 DYKE, A.S., and ZOLTAI, S.C. - 1980
Radiocarbon-dated mudboils, Central Canadian Arctic; *in* Current Research, Scientific and Technical Notes, Part B; Geol. Surv. Can., Paper 80-1B, pp. 271-275.

Mudboils, a type of sorted or nonsorted circle, are probably the most common patterned ground features in the central Canadian Arctic. They are ubiquitous on till and on diamictic residual soils formed by weathering of bedrock. Related raised, hemispherical forms, referred to as earth or mud hummocks, occur on marine silts and clays in the central Arctic and on clay-rich tills and colluvium in the western Arctic. Buried organic materials are common in earth hummocks; most are less than 4500 years old.

Three mudboils in till, excavated on Boothia Peninsula, Somerset Island, and central District of Keewatin, had well developed subducted organic layers. The organic materials were sampled for radiocarbon dating to determine long-term average rates of subduction of material in mudboil edges, and the tills were sampled to measure their physical properties.

2016 DYKE, A.S. - 1980
Base metal and uranium concentrations in till, Northern Boothia Peninsula, District of Franklin; *in* Current Research, Scientific and Technical Notes, Part C; Geol. Surv. Can., Paper 80-1C, pp. 155-159.

Till samples from the northern half of Boothia Peninsula have been analyzed for base metal and uranium contents. Twenty-two samples collected in 1974 were analyzed for Cu, Pb, Zn, Co, Ni, and U; 280 samples collected in 1978 were analyzed for these elements plus Cr, Mo, Mn, and Fe.

This note presents contour maps and histograms for each element and relates findings to the local geology to the extent possible.

2017 DYKE, A.S. - 1981
Late Holocene solifluction rates and radiocarbon soil ages, Central Canadian Arctic; *in* Current Research, Part C, Geol. Surv. Can., Paper 81-1C, pp. 17-22.

Twelve radiocarbon dates on humus buried beneath four solifluction lobes indicate long-term overage solifluction rates of 2.2, 3.3, ≥ 3.5, and 1.3 mm/year. The lobes are composed of till, sand, bouldery gravel, and cobble gravel on slopes of 2^{o} to 25^{o}. Availability of moisture seems to be more important than slope angle or texture in determining solifluction rates. The rates of advance of two lobes have varied through time, though not synchronously. Radiocarbon ages of soils at time of burial range from 285 to 953 years and are important components of the radiocarbon ages of the paleosols. Twelve other radiocarbon-dated lobes from other parts of the world experienced similar rates of movement.

2018 DYKE, L.D. - 1981
Bedrock heave in the Central Canadian Arctic; *in* Current Research, Part A, Geol. Surv. Can., Paper 81-1A, pp. 157-167.

Resurveys of sites established for the measurement of rock heave has shown that yearly movement of up to at least 5 cm takes place where pressures accompanying the freezing of water in soil bodies associated with rock (till deposits, fracture fillings, weathering products) can be transmitted to rock. Movement is less where pressure is developed in free water that becomes trapped between downward-advancing freezing fronts and permafrost, but pressures in this confined water have been shown in the field and laboratory to reach at least 400 kPa. These two processes give rise to a variety of rock heave features.

2019 FORBES, D.L. - 1980
Late Quaternary sea levels in the southern Beaufort Sea; *in* Current Research, Part B, Geol. Surv. Can., Paper 80-1B, pp. 75-87.

Data on late Quaternary sea levels in the Beaufort Sea are extremely limited, yet the sea level chronology in this area is of some importance for studies of continental ice loading, submarine permafrost and ice scour, and deltaic sedimentation. The evidence suggests that deviations from published eustatic curves have occurred in the region, and indeed the concept of local correspondence with a worldwide eustatic pattern appears to be outmoded. A hypothetical history for the Mackenzie Delta is proposed which includes limited isostatic depression due to late Wisconsin ice, minor uplift, and renewed subsidence due to forebulge collapse or sediment loading. A mid-Wisconsin transgression of the order of 10 m higher than present sea level is suggested by evidence in the Mackenzie Delta area and in north Alaska, but no evidence for sea levels higher than present since the late Wisconsin has been found west of Cape Bathurst. Coastal morphology, radiocarbon and archeological dates, and plausible mechanisms suggest a recent and perhaps continuing regional submergence. The tidal record at Tuktoyaktuk is insufficient to resolve the contemporary trend of sea level.

2020 FORSYTH, D.A., MAIR, J.A., and FRASER, I. - 1979

Crustal structure of the central Sverdrup Basin; *Can. J. Earth Sci.*, vol. 16, no. 8, pp. 1581-1598.

A synthesis of refraction data recorded in 1972 and 1973 in the central Sverdrup Basin with other geophysical data shows major features which correlate well with the regional geological structure. The record sections from the Arctic Archipelago show little coherent secondary energy compared with those from other areas of Canada. Normalization of the sections to remove effects of varying shot size and instrument gain has revealed a significant loss of amplitude and coherence of the upper and mid-crustal phases of the seismic energy on traversing a major northeast-trending structure between Melville and Lougheed Islands. The upper mantle phase (P_n), however, is not abnormally attenuated in its travel beneath the area. The aeromagnetic data reveal a major series of dykes or minor graben, a likely cause of scattering and attenuation of the seismic energy travelling within the crust. These seismic effects and the focal depths of earthquakes suggest that lateral heterogeneities in the crust may extend to near-mantle depths in this area. The age dates available suggest fracture or dyke development progressed from south to north beginning in the Early Cretaceous. The correlation of the recorded seismicity with these structures provides one of the better examples of an active, intraplate tectonic feature.

East of King Christian Island (KCI) the refraction results concur with gravity and regional geology in suggesting a major change in crustal and upper mantle structure. Models derived using ray theory indicate a crust which thins from near 40 km beneath the eastern Sabine Peninsula to 32 km west of KCI. East of KCI the Moho may lie at 40 km beneath a complex crustal structure. The average crustal compressional wave velocity is between 5.9 and 6.4 km s^{-1} and the mean upper mantle velocity is 8.2 km s^{-1}. The present study does not support the existence of a distinct mid-crustal layer with a velocity of about 7.3 km s^{-1}.

2021 FRENCH, H.M. - 1978
Sump Studies: 1 Terrain Disturbances; *Ind. & Northern Affairs*, North of 60 Environmental Studies No. 6, Cat. R71-19/6-1978, ISBN 0-662-10182-0, 52 p.

Forty-seven abandoned wellsites in the Mackenzie Delta and Arctic Islands are analysed with respect to terrain and land use problems encountered. Approximately 30% of the sites visited experienced problems related either directly or indirectly to sumps and/or the containment of waste drilling fluids. These problems are classified as follows: (1) Type A - non-containment during drilling, (2) Type B - melt-out problems during summer operations, and (3) Type C - restoration problems. Type C problems are the most common and include sump subsidence and collapse, non-containment of fluids during sump infill, subsurface leakage of fluids, and excessive terrain disturbance adjacent to the sump. The least problems appear associated with one-season winter drilling operations. Two-season winter drilling, in which the sump is left open during the summer, and one-season summer drilling operations usually present more problems.

A number of possible alternate sump fluid disposal methods are mentioned. These include the direct disposal of fluids upon tundra in certain instances, notably polar desert environments, dilution into water bodies in certain flood plain and coastal locations, and the trucking of fluids to central containment sites.

2022 FRENCH, H.M., and SMITH, M.W. - 1980
Sump Studies 11 - Geothermal Disturbances in Permafrost Terrain Adjacent to Arctic Oil and Gas Wellsites; *Ind. & Northern Affairs*, Northern Affairs Program Environmental Studies No. 14, Cat. R71-19/14-1980E, ISBN 0662-10961-9, 61 p.

Two sumps, one at the Panarctic Bent Horn 1-01 wellsite on Cameron Island (76°N, 104°W) and the other at the Gulf Ogruknang M-31 wellsite in the Caribou Hills (69°N, 134°W), were instrumented during the 1976-77 winter to monitor geothermal conditions in the enclosing permafrost. Numerical simulation based upon observed field data is used to predict geothermal changes. Bent Horn 1-01 was a one season winter drilling operation; Ogruknang M-31 was a two season winter drilling operation in which the sump was left open during summer and infilled during the second winter.

At 1-01 sparse data indicate that sump fluids froze virtually instantaneously upon entering the sump and have remained frozen after site restoration. At M-31 the sump fluids were not completely frozen at the time of infilling. At both sites, permafrost temperatures beneath the sump rose significantly during the period of well drilling. Data from M-31 indicate (a) temperatures at a depth of 0.5 m below the sump floor rose rapidly from -14 to -4°C during the early stages of sump use and then rose slowly to -0.5°C by mid September 1977, (b) thawing of permafrost during the summer of 1977 was restricted to the sump walls, (c) at a depth of 2.5 m below the sump floor geothermal disturbances became minimal, and (d) by July 1978, temperatures at a depth of 2.0 m below the sump floor had achieved a quasi-equilibrium of -1 to -2°C.

These data suggest that the use of below ground sumps to contain waste drilling fluids at the two localities described does not lead to permafrost degradation, and that sump fluids, if not completely frozen at the time of infilling, eventually freeze *in situ* in the permafrost. In areas of warmer permafrost and/or higher summer temperatures, the same conclusions may not apply.

2023 FRENCH, H.M., and SMITH, M.W. - 1980
Geothermal disturbance resulting from sump construction and use in permafrost terrain, Arctic Canada; *in* Proc. Sym. Res. on Environmental Fate and Effects of Drilling Fluids and Cuttings, Lake Buena Vista, Florida, January 21-24, 1980, Ind. & Northern Affairs, vol. 1, pp. 139-164.

2024 FRENCH, H.M. - 1980

Periglacial geomorphology and permafrost; *Progress in Physical Geography*, vol. 4, no. 2, pp. 254-261.

The move into a new decade provides an excuse here for speculation as to future trends and developments in periglacial geomorphology. To do this, it is necessary to characterize progress during the past decade and place the developments of the 1970s in their historical perspective.

2025 FRENCH, H.M. - 1980

Terrain, Land Use and Waste Drilling Fluid Disposal Problems, Arctic Canada; *Arctic*, vol. 33, no. 4, pp. 794-806.

A survey of over 60 abandoned wellsites in the Mackenzie Delta, the Arctic Islands and the interior Yukon Territory indicated that approximately 25% of the sites experienced terrain problems related either directly or indirectly to sumps and/or the containment of waste drilling fluids. These problems are classified as follows: (A) non-containment during drilling, (B) melt-out problems during summer operations, and (C) restoration problems. Fewest problems are associated with one-season winter drilling operations. Two-season winter drilling, in which the sump is left open during the summer, and one-season summer drilling operations present more problems.

2026 FRENCH, H.M. - 1981

Periglacial geomorphology and permafrost; *Progress in Physical Geography*, vol. 5, no. 2, pp. 267-273.

2027 FRENCH, H.M., and LEWKOWICZ, A.G. - 1981

Periglacial slopewash investigations, Banks Island, Western Arctic; *Biuletyn Peryglacjalny*, no. 28, pp. 33-45.

Three small run-off plots, located in north-central Banks Island, were used in a reconnaissance study of the hydrologic and geomorphic importance of downslope water movement during the summer of 1977. Positive correlations were observed between net radiation, sensible heat transfer, and run-off production. In addition, summer precipitation generated surface flow with low run-off coefficients.

Suspended and dissolved sediment concentrations in surface run-off were low suggesting that slopewash is not a major denudational process in this environment. Some support is given to the concept of partial area contribution to run-off in permafrost regions.

2028 FRISCH, T. - 1981

Further reconnaissance mapping of the Precambrian Shield on Devon Island, District of Franklin; *in* Current Research, Part A, Geol. Surv. Can., Paper 81-1A, pp. 31-32.

The Precambrian basement of eastern Devon Island appears to consist of alternating, broad, easterly-trending belts of biotite- and hypersthene-bearing granulites and chiefly pelitic metasediments, all in the granulite facies of metamorphism. The easterly structural grain in eastern Devon Island contrasts with the predominantly northerly trends in the adjacent basement terrane of southeastern Ellesmere Island and Coburg Island. Paleozoic carbonate rocks, previously unknown east of the Devon Ice Cap, were found over an extensive area on western Philpots Island.

2029 GAGNÉ, R.M. - 1980

Cruise Report: CCGS, Nahidik, Beaufort Sea 1980; *Geol. Surv. Can.*, internal report, 79 p.

The objective of this cruise was to obtain geological information on the structure of near surface sediments by geophysical methods as an aid in the interpretation of the quaternary geological history of the Southern Beaufort Sea.

2030 GORDEY, S.P. - 1981

Geology of Nahanni Map-area, Yukon Territory and District of Mackenzie; *Geol. Surv. Can.*, Open File No. 780.

This file consists of a 1:125 000 scale geological map and structure section (105I), six 1:50 000 scale geological maps (105I/6,7,8,9, 10 and 16), a legend, and diagrams depicting stratigraphic relationships and thicknesses. It replaces a previous open file on the same area (O.F. 689, April 1980) which presented only partial coverage at 1:125 000 scale. The 1:50 000 scale maps have been brought forward from the previous file with minor revisions.

2031 HAYWARD, M., and FRENCH, H.M. - 1980

Pleistocene marine kettle-fill deposits near Ottawa, Canada; *Can. J. Earth Sci.*, vol. 17, no. 9, pp. 1236-1245.

Exposures at several localities in the Ottawa region reveal Champlain Sea deposits filling depressions on what were formerly submerged surfaces of Wisconsin sand and gravel ridges. The deposits, referred to as "kettle fill", constitute materials eroded from the ridges in a marine environment and redeposited in ice-melt depressions or kettle holes. Processes responsible for the deposition of the sediment appear to include debris flows and small turbidity currents initiated by wave washing and slope instability. The dimensions of the depressions, their depth in relation to the falling wave base, and the steepness of the flanks were important factors controlling sedimentation. The kettle-fill facies comprise diamicton (pebbly mud), gravel, sand, and lutite.

2032 HÉLIE, R.G. - 1981

Differentiation and genesis of diamictons on Somerset Island, N.W.T.; unpub. M.Sc. thesis, McGill Univ., 109 p.

Diamictons in Canadian Arctic areas such as Somerset Island may be glacigenic till or the result of weathering. Periglacial processes have modified or destroyed most primary characteristics and in some places have mixed diamictons of different origins. A laboratory experiment showed that diamictons also can form as a result of weathering caused by repeated freeze-thaw cycles and by dissolution of limestone leaving insoluble residues.

The most effective laboratory method of recognizing the origin of Arctic diamictons is by X-ray diffraction of the clay-size fraction; tills show the well defined peaks of quartz, feldspar and chlorite whereas weathered rock diamictons show broad, poorly defined peaks. Grain-size distributions of the two principal diamictons are not diagnostic, of a specifid origin, though for 53 samples of till skewness was 0.12 (σ±0.24) and for 36 samples of weathered bedrock 0.058 (σ±0.25). Under the scanning electron microscope, quartz shows conchoidal fractures that could result from either glacial abrasion or frost action; however, etch features are more abundant in weathered rock than in till, which contains material derived from much older rocks that already had these features.

2033 HOBSON, G.D. - 1980
The Lomonosov Ridge Experiment: "LOREX'79"; *MUSK-OX*, vol. 26, pp. 51-58.

2034 HODGSON, D.A. - 1978
Surficial materials, Southern Ellef Ringnes and King Christian Islands, N.W.T.; *Geol. Surv. Can.*, Open File No. 538.

This is a preliminary draft of a map with a separate legend describing surficial materials on Ellef Ringnes Island south of 78°30'N and King Christian Island, N.W.T. (part of 69C,D, E,F, and 79E). The data is based on airphoto interpretation, and on field data collected in 1976-77. The map scale is 1:125 000.

An inset map shows generalized surficial materials units at a scale of 1:250 000. Separate legends for Ellef Ringnes and King Christian islands describe each unit in terms of materials, topography, drainage, geomorphological processes, ground ice content, river bank and shoreline characteristics, terrain sensitivity and trafficability.

1940 HODGSON, D.A., and EDLUND, S.A. - 1978
Surficial materials and vegetation, Amund Ringnes and Cornwall Islands, District of Franklin; *Geol. Surv. Can.*, Open File No. 541.

2035 HODGSON, D.A. - 1981
Surficial geology, Lougheed Island, Northwest Arctic Archipelago; *in* Current Research, Part C, Geol. Surv. Can., Paper 81-1C, pp. 27-34.

The surficial materials on Lougheed Island and adjacent Edmund Walker Island are mainly weathered soft shale and sandstone at high elevations, and a complex of weathered rock, and glaciomarine, marine, deltaic and fluvial sediments over the remaining area. Glacial till, and associated deformation of the soft bedrock, are exposed only in section. The direction of the deforming force, the source of erratics, and alignment of drumlinoid ridges and a possible esker, indicate ice movement from the southeast; the age of the responsible glacial event is not known and may well be prelate Quaternary. Rapid deposition of glaciomarine, and subsequently marine, sediment was in progress at 10 500 ± 130 years ago, while emergence of at least 90 m has occurred since 10 240 ± 280 years ago. The cause of uplift and the origin of the glaciomarine sediments is suggested to be break-up of an ice sheet to the south, covering at least Bathurst Island 10 500 years ago, and producing floating ice, or even an ice shelf which extended to Lougheed Island; however, latitudinal compressive tectonic forces might also be responsible for uplift.

2036 JACKSON, G.D., IANNELLI, T.R., and TILLEY, B.J. - 1980
Rift-related Late Proterozoic sedimentation and volcanism on northern Baffin and Bylot Islands, District of Franklin; *in* Current Research, Part A, Geol. Surv. Can., Paper 80-1A, pp. 319-328.

More than 5600 m of late Proterozoic quartzarenites, shales, stromatolitic and biohermal carbonates, arkoses, greywackes and conglomerates, were deposited in environments ranging from fluvial to subtidal on northern Baffin and Bylot Islands. A delta-fan complex occurs in the lower part of the succession, coastal sabkha-type evaporites in the middle part, and an alluvial fan complex in the upper part. As much as 80 m of tholeiitic plateau basalts occur near the base of the succession.

Syndepositional faulting had a significant effect on the sedimentation pattern. Paleocurrent trends are varied, but most indicate northwesterly transport in central graben areas and in some horst areas. Transport away from fault zones active during sedimentation and toward central graben areas, is indicated in marginal trough areas. Rifting was probably related to a late Proterozoic ocean opening event to the northwest; perhaps an early phase of the Franklinian Geosyncline.

2037 JACKSON, G.D., and CUMMING, L.M. - 1981
Evaporites and folding in the Neohelikian Society Cliffs Formation, Northeastern Bylot Island, Arctic Canada; *in* Current Research, Part C, Geol. Surv. Can., Paper 81-1C, pp. 35-44.

Redbed and associated coastal marine gypsum-bearing, sabkha sequences occur within the lower member of the Neohelikian Society Cliffs Formation of eastern Borden (Rift) Basin. Intricate folds and numerous steep, small-scale, faults occur in these strata on northeastern Bylot Island. These structures probably developed prior to emplacement of Hadrynian Franklin diabase dykes, and Phanerozoic sedimentation in the region. The folds developed partly in response to movement along nearby major fault zones, but the style of folding was controlled predominantly by the volume of contained evaporites. Although the preserved evaporite mineral is gypsum, data suggest that percolating water removed original halite.

2038 JONES, B. - 1979
Atrypoidea erebus N. Sp. from the Late Silurian of Arctic Canada; *J. Paleontology*, vol. 53, no. 1, pp. 187-196.

The Late Silurian Read Bay and Somerset Island Formations of Arctic Canada contain a suite of stratigraphically useful species of the spire-bearing brachiopod *Atrypoidea*. *Atrypoidea erebus* n. sp. is the youngest species in the sequence and defines a biostratigraphic zone that is useful for correlation purposes. On Somerset, Prince of Wales and Cornwallis Islands *Atrypoidea erebus* occurs in Late Ludlovian and/or Early Pridolian strata.

2039 JONES, B. - 1979
Atrypoidea zonation of the Upper Silurian Read Bay Formation of Somerset and Cornwallis Islands, Arctic Canada; *Can. J. Earth Sci.*, vol. 16, no. 12, pp. 2204-2218.

Species of the brachiopod genus *Atrypoidea* have a distinct distribution in carbonate rocks of the late Silurian Read Bay Formation of Arctic Canada. *Atrypoidea phoca* occurs in the basal part of the formation and this species is succeeded by *Atrypoidea foxi* forma B at higher levels. The ranges of the two species overlap, defining a third useful zone. Locally, as in the Pressure Point area of northwestern Somerset Island, *Atrypoidea foxi* forma B is succeeded by *Atrypoidea foxi* forma A. *Atrypoidea foxi* forma A is generally restricted to carbonates with a low content of detrital material and has a significantly larger shell than *Atrypoidea foxi* forma B. A higher zone is defined by *Atrypoidea erebus* which occurs in the basal part of the Somerset Island Formation on Somerset Island and in the basal part of member C of the Read Bay Formation at Goodsir Creek on Cornwallis Island. At the latter locality, *Atrypoidea foxi* forma A is found with *Atrypoidea erebus*, thereby demonstrating their overlapping ranges.

The overlapping ranges of *Atrypoidea phoca* and *Atrypoidea foxi* forma B occur in the middle to late Ludlovian *ploeckensis-siluricus* conodont zones. On Somerset Island, *Atrypoidea foxi* forma B and *Atrypoidea foxi* forma A range through the *ploeckensis-siluricus* conodont zone. *Atrypoidea erebus* occurs in late Ludlovian and (or) early Pridolian strata.

2040 JONES, B. - 1978
Nanukidium, a new name for *Rossella* Jones; *J. Paleontology*, vol. 53, no. 5, p. 1261.

2041 JONES, B., OLDERSHAW, A.E., and NARBONNE, G.M. - 1979
Nature and origin of rubbly limestone in the Upper Silurian Read Bay Formation of Arctic Canada; *Sediment. Geol.*, vol. 24, pp. 227-252.

The Upper Silurian Read Bay Formation of Somerset and Cornwallis Islands contains a very distinctive rock herein termed rubbly limestone. This rock, formed of hard 'lumps' and beds of limestone in a softer matrix can be divided into rubbly argillaceous limestone for those rocks with an argillaceous matrix, and rubbly mottled dolomitic limestone for those rocks with a dolomitic matrix. Detailed field, petrographic and paleontological analyses indicate that the rubbly limestones are probably the result of incipient subtidal lithification that occurred at a very early stage after deposition. The exact form of the rubbly limestone was controlled by the original nature of the sediment, the rate of sedimentation, the degree of early lithification and the degree of dolomitization.

Lumps encrusted by bryozoans and tabulate corals and lumps with micritized upper and/or lower surfaces are rare. Most lumps show evidence of burrowing; however, in some cases there is evidence that the burrowers purposely avoided the lumps. These features suggest that lithification occurred near the deeper limits of burrowing and storm exhumation.

Dolomitization preferentially followed the more permeable zones between the limestone lumps and apparently occurred at a very early stage in the diagenetic history of the rock.

2042 JONES, B., and PACKARD, J. - 1980
Atrypoidea polaris: a new atrypoid brachiopod species from Arctic Canada; *J. Paleontology*, vol. 54, no. 3, pp. 577-583.

Atrypoidea polaris n.sp. is a large, smooth, convexo-plane atrypoid brachiopod that may be the last of the *Atrypoidea* lineage in Arctic Canada. It occurs above *Atrypoidea foxi* and from morphological analysis it would appear that *A. polaris* evolved from *A. foxi*. It occurs in strata of late Pridolian age, 80 m below the boundary between Members C and D of the Read Bay Formation on Cornwallis Island. It may be biostratigraphically useful in so far as it is the only species of *Atrypoidea* from this interval of the platform sequence in Arctic Canada.

2043 JONES, B. - 1981
The Silurian Brachiopod *Stegerhynchus*; *Palaeontology*, vol. 24, part 1, pp. 93-113.

The brachiopod *Stegerhynchus* Foerste, 1909 occurs in Silurian strata in Canada, the U.S.A., the U.S.S.R., Gotland, and the United Kingdom. Review of the literature shows that *Rhynchonella whitii praecursor* Hall, 1863 is the true type species of *Stegerhynchus*. Although *Stegerhynchus* and *Ferganella* Nikiforova, 1937 are morphologically very similar, they can be separated because *Stegerhynchus* has an open notothyrial cavity that houses an elongate cardinal process based on the notothyrial platform, whereas *Ferganella* has a septal process extending anteriorly from the posteriorly conjunct hinge plates. The septal process joins the cardinal process distally. *Stegerhynchus* seems to be most common in Wenlock and Ludlow strata and less common in Llandovery and Pridoli strata. *Ferganella* appears to be of Pridoli/Lower Devonian age. Species such as *S. borealis* and *S. diodonta* are relatively long-ranging while other species such as *S. anga-*

ciensis have a relatively short range. S. *borealis* is relatively common in the Upper Silurian Read Bay Formation of the Canadian Arctic islands, whereas S. *angaciensis* is relatively rare, being found only at the base of member C of the Read Bay Formation on the east coast of Cornwallis Island.

2044 KLASSEN, R.A. - 1981
Aspects of the glacial history of Bylot Island, District of Franklin; *in* Current Research, Part A, Geol. Surv. Can., Paper 81-1A, pp. 317-326.

Erratics derived from north-central Baffin Is. prove that large glaciers have moved onto Bylot Island across both the north and south coasts. The maximum elevation to which such debris has yet been found is about 1100 m a.s.l. and these high-level erratics are considered to have been emplaced prior to the 'last' glaciation. During the 'last' glaciation ice form offshore sources carried debris to maximum elevations of between 300 and 550 m a.s.l.; debris was carried by two glaciers - the first flowed northward through Admiralty Inlet and then eastward within Lancaster Sound while the second flowed northward through Milne Inlet and then eastward within Pond Inlet. Both glaciers were grounded within the marine channels that they occupied. Shell fragments from glacial and derived deposits associated with that stade have minimum amino acid ratios (free) of about 0.3. Shells from material deposited after that event are more than 35 000 radiocarbon years old and have amino acid ratios of about 0.24. Subsequent to the maximum of the last glaciation, Bylot glaciers expanded 10 to 15 km beyond their present limits.

2045 KRUPICKA, J. - 1973
Granulite facies rocks on Northeastern Devon Island, Arctic Archipelago; *Geol. Surv. Can.*, Paper 73-8, 41 p.

Rocks of the granulite facies occur on northeastern Devon Island in the Churchill Province of the Canadian Shield. These rocks probably represent elements of an Archean basement reworked during the Hudsonian Orogeny.

The rocks are high-grade hypersthene-quartz-plagioclase gneisses grading into retrogressively metamorphosed amphibolite facies gneisses. The granulites together with the retrograded rocks constitute a metamorphic series marked by: alteration and disappearance of hypersthene; decrease in the amount and in the An-content of plagioclase; increase in the amount of potassium feldspar and the development of typical microcline; increase in the amount of biotite and, in the most regressed stages, of chlorite; tendency to increasingly inequigranular texture and porphyroblastesis; and a general trend towards more massive and granite-like rocks. The whole process was essentially crystalloblastic, and only rarely has led to full-scale mobilization and capacity for intrusion.

Retrogressive metamorphism, microclinization and granitization were more intense where the process was supported by strong mechanical reworking.

The metamorphic complex is cut by younger diabase dykes, and is unconformably overlain by Cambrian sediments belonging to the eastern regions of the Arctic Platform. The sedimentary sequence starts with a thin basal sandstone, and continues with mainly dolomitic rocks.

2046 LEWIS, C.F.M. - 1978
The frequency and magnitude of drift-ice groundings from ice-scour tracks in the Canadian Beaufort Sea; *in* Proc. POAC 4th Intern. Conf. on Port and Ocean Engineering under Arctic Conditions, vol. I, Mem. Univ. Nfld., St. John's, Nfld., Sept. 26-30, 1977, pp. 568-579.

A study of the morphology of ice scours in the Canadian Beaufort Sea and their variation with water depth is described. Within specific bathymetric zones scour depth frequencies are distributed exponentially and Gumbel's extreme-value distribution is used to describe maximum scour depths. When combined with related information on sedimentation, the drift-ice regime, and sea level change, the statistical nature of ice-scour tracks is used to: (1) differentiate areas of contemporary and relict scouring and (2) build a theory for estimating the rate of scour additions for various depths of ice keel penetrations beneath the seabed. Scour additions measured over periods of a few years by repetitive seafloor mapping are described also.

2047 LEWIS, C.F.M. - 1980
North Pole geology under the sea ice at LOREX 79; *in* Proc. Geolog Newsletter of the GAC, Ed. G.L. Williams, Winter 1980, vol. 9, part 1, pp. 58-64.

During April and May 1979, the Department of Energy, Mines & Resources conducted a major polar expedition to investigate the nature and origin of the Lomonosov Ridge near the North Pole. This ridge, equivalent in relief and size to a major mountain range, rises almost 3,000 m above the floor of the Arctic Ocean and extends about 1,700 km between northern Canada and U.S.S.R.

According to some theorists, the ridge is an ancient sliver of the Eurasian continent that was shifted to its present position by rifting and sea floor spreading processes within the last 60 million years. Others suggest the ridge stands as mute and relict evidence of former upheavals and buckling of the oceanic crust possibly with outpourings of volcanic rocks. Clearly the formation of such an extensive feature has played a major role in the evolution of the Arctic Ocean basin, and a proper understanding of the timing and mechanics of its emplacement is bound to improve our understanding of the continental margins surrounding the Arctic Ocean including the rocks and resources of Arctic Canada.

2048 LEWKOWICZ, A.G. - 1981
A study of slopewash processes in the continuous permafrost zone, Banks Island, Western Canadian Arctic; unpub. Ph.D. thesis, Univ. Ottawa, 297 p.

The magnitude and frequency of slopewash processes in the continuous permafrost zone were studied during three summer field seasons (1977-1979). Hydrological and geomorphological aspects of the processes were examined at four small runoff plots located in north-central Banks Island, N.W.T.

Slope hydrological processes exhibited a high degree of variability, both in inter-site and inter-year comparisons. At all sites, however, snowmelt was the most important input and summer precipitation was of very limited significance. During the study, rainfall caused surface flow to develop on two occasions, and then only in areas near or at saturation due to antecedent snowmelt. Consequently, the partial area contribution theory of stream runoff production appears the most valid conceptual model for the study area. Snowmelt-generated surface runoff coefficients at the plots varied on a daily basis in response to energy inputs, and on an annual basis in response to melt season meteorological conditions and winter snow distribution. Only the largest snowbank studied produced a seasonal surface runoff coefficient exceeding 50%.

Suspended sediment concentrations in surface wash were very low, and weight loss due to this process was correspondingly insignificant. The influence of vegetation in protecting the ground surface from the high unit discharges developed at the snowbank sites was of prime importance, and the maximum suspended sediment concentrations (70 mg L^{-1}) occurred at the interfluve site which was largely unvegetated. In contrast, dissolved sediment concentrations were high in both surface and subsurface wash, and surface lowering at the plots by these processes exceeded that by suspended sediment removal by 16 to 250 times. Total rates of denudation by slopewash ranged from 6.2×10^{-3} to 105.4×10^{-3} mm a^{-1} averaged over the plot areas, and from 15.4×10^{-3} to 350.4×10^{-3}mm a^{-1} averaged over the partial areas of the plots actually affected by wash. In both cases, the maximum lowering rate occurred at the largest snowbank, and the minimum at the interfluve location. The results suggest that in permafrost areas slopewash can be an important agent of denudation, but in locations where vegetation growth is promoted by high unit discharges, its effects are mainly through solution and not particle sediment removal.

2049 MACKAY, J.R., KONISHCHEV, V.N., and POPOV, A.I. - 1979
Geologic Controls of the Origin, Characteristics, and Distribution of Ground Ice; *in* Proc. 3rd Intern. Conf. Permafrost, Ottawa, Ont., sponsored by Nat. Res. Council of Can., vol. 2, pp. 1-18.

The geologic controls of the origin, characteristics, and distribution of ground ice in the permafrost areas of the world are numerous. The review authors are very conscious of the fact that in a brief survey of the more than 300 papers which have been published since 1973, it is obviously impossible to discuss all topics and to do justice even to those topics which are discussed. The sequence of topics, in this summary, are the same as for the longer review paper which contains the bibliographic references omitted in this summary.

2050 MACKAY, J.R. - 1979
Pingos of the Tuktoyaktuk Peninsula area, Northwest Territories; *Geogr. phys. Quat.*, vol. XXXIII no. 1, pp. 3-61.

Most pingos have grown in residual ponds left behind by rapid lake drainage through erosion of ice-wedge polygon systems. The field studies (1969-78) have involved precise levelling of numerous bench marks, extensive drilling, detailed temperature measurements, installation of water pressure transducers below permafrost and water (ice) quality, soil, and many other analyses. Precise surveys have been carried out on 17 pingos for periods ranging from 3 to 9 years. The field results show that permafrost aggradation in saturated lake bottom sediments creates the high pore water pressures necessary for pingo growth. The subpermafrost water pressures frequently approach that of the total lithostatic pressure of permafrost surrounding a pingo. The water pressure is often great enough to lift a pingo and intrude a sub-pingo water lens beneath it. The basal diameter of a pingo is established in early youth after which time the pingo tends to grow higher, rather than both higher and wider. The shutoff direction of freezing is from periphery to center. When growing pingos have both through going taliks and also permeable sediments at depth, water may be expelled downwards by pore water expulsion from freezing and consolidation from self loading on saturated sediments. Pingos can rupture from bursting of the sub-pingo water lens. Otherwise, pingo failure is at the top and periphery. Hydraulic fracturing is probably important in some pingo failures. Water loss from sub-pingo water lenses causes subsidence with the subsidence pattern being the mirror image of the growth pattern; i.e. greatest subsidence at the top. Small peripheral bulges may result from subsidence. Old pingos collapse from exposure of the ice core to melting by overburden rupture, by mass wasting, and by permafrost creep of the sides.

2051 MACKAY, J.R., and BURROUS, C. - 1979
Uplift of objects by an upfreezing ice surface; *Can. Geotech. J.*, vol. 16, no. 3, pp. 609-613.

Laboratory and field experiments show that many kinds of solid objects are readily uplifted by an upfreezing ice surface and that uplift pressures can approximate the heaving pressures for soils with similar pore sizes. Uplift can be explained by ice-segregation theory. Frost heave by ice segregation against stones at the bottom of the active layer in an area of continuous permafrost is considered.

2052 MACKAY, J.R. - 1980
Deformation of ice-wedge polygons, Garry Island, Northwest Territories; *in* Current Research, Part A, Geol. Surv. Can., Paper 80-1A, pp. 287-291.

In 1966 twenty-five steel tubes were inserted vertically into holes in an area of low centre polygons. Long term (1966-79) measurements of the changes in distance between the steel tubes, changes in tilt of the tubes, and the development of cavities preferentially on one side of the tubes show that the active layer of low centre polygons moves past the tubes. Because the cavities are confined to the active layer and movement tends to be radially outward from polygon centres, the movement is attributed to summer thermal expansion. Differential movement has implications for the interpretation of stratigraphies based upon ice-wedge sections. In view of the strong evidence for thermally induced movement in flat areas, thermally induced movement of the active layer may also occur on slopes.

2053 MACKAY, J.R. - 1980
Illisarvik: an experiment in lake drainage; *in* Proc. Sym. Permafrost Geophysics (No. 5), Nov. 13-14, 1978, eds. W.J. Scott and R.J.E. Brown, Nat. Res. Council Tech. Memo. No. 128, pp. 1-5.

2054 MACKAY, J.R. - 1980
The origin of hummocks, western Arctic coast, Canada; *Can. J. Earth Sci.*, vol. 17, no. 8, pp. 996-1006.

Hummocks (nonsorted circles) are widely distributed in arctic and subarctic regions. The hummocks under discussion are composed of fine-grained frost-susceptible soils; the late summer frost table is bowl-shaped; and the hummocks grade from those which are completely vegetated (earth hummocks) to those with bare centres (mud hummocks). The mound form is usually attributed to an upward displacement of material resulting from cryostatic (freeze-back) pressure generated in a confined, wet, unfrozen pocket of the active layer. Theoretically, cryostatic pressure should not develop in a frost-susceptible hummock soil, bebecause ice lensing at the top and (or) bottom of the active layer will desiccate the last unfrozen pocket so that the pore water is under tension, not pressure. Field observations carried out at Garry Island, Northwest Territories, for 1965-1979 and for 1967-1979 at Inuvik, Northwest Territories, involving: summer and winter excavations, the measurement of the deformation of tubes, soil pressure, soil temperature, soil heave, soil moisture migration; and observations on hummock stability provide no field evidence for the cryostatic theory. An alternative model of hummock growth, based upon field observations, is here proposed. The upward displacement of material is believed caused by freeze-thaw of ice lenses at the top and bottom of the active layer with a gravity-induced cell-like movement, because the top and bottom freeze-thaw zones have opposite curvatures. The cell circulation is evident from the grain-size distribution of hummock soils and from upward-moving tongues of saturated soil observable in late summer. The most active period is in late summer. Model experiments in the laboratory have been successful in producing mounds by freeze-thaw of a kaolin slurry in a bowl-shaped container in support of the proposed theory.

2055 MACKAY, J.R. - 1980
Ridge growth of ice-wedge polygons, western Arctic, Canada; *Abstract in* 24th Intern. Geogr. Congress, Sept. 1-5, 1980, Tokyo, Japan, Main Session Abstracts Vol. 1, pp. 86-87.

2056 MACKAY, J.R. - 1981
Active layer slope movement in a continuous permafrost environment, Garry Island, Northwest Territories, Canada; *Can. J. Earth Sci.*, vol. 18, no. 11, pp. 1666-1680.

Field investigations have been carried out at Garry Island, N.W.T. for the 1964-1980 period in order to study downslope active layer movement at sites with two-sided (downward and upward) freezing and active ice-wedge growth. Movements have been determined with reference to semi-flexible plastic tubes inserted vertically into the ground and by deformation of lines of stakes. The results show that the vertical velocity profile on the hillslopes with clayey hummocks is convex downslope; the movement is plug-like and occurs in late summer; the plug-like movement progressively buries the interhummock peat to form a buried organic layer; and most of the plug-like movement can be attributed to frost creep by thaw of an ice-rich layer at the bottom of the active layer. The ice-rich layer forms by upfreezing in winter and the ice content may be augmented by ice lensing in the summer thaw period. In a sedgy drainage swale, the vertical velocity profile is concave downslope. The active layer of ice-wedge polygons shows a net movement outwards from the centres to the troughs. These studies show that active layer movement at sites with two-sided freezing and active ice-wedge polygons may differ substantially from sites with only one-sided freezing and without active ice-wedge polygons.

2057 MACKAY, J.R. - 1981
Aklisuktuk (Growing Fast) Pingo, Tuktoyaktuk Peninsula, Northwest Territories, Canada; *Arctic*, vol. 34, no. 3, pp. 270-273.

Field surveys have been carried out for the 1972 to 1979 period in order to study the growth of Aklisuktuk (Growing Fast) Pingo. The field surveys show that the top of the pingo was slowly subsiding during the seven-year survey period, possibly from a slow downslope glacier-like creep of the ice-rich overburden and ice core. The name "Aklisuktuk" probably dates back at least 200 years. The rapid growth which attracted attention was from accumulation of water in a large sub-pingo water lens.

2058 MACKAY, J.R. - 1981
Dating the Horton River breakthrough, District of Mackenzie; *in* Current Research, Part B, Geol. Surv. Can., Paper 81-1B, pp. 129-132.

Horton River, which is one of the large rivers of the Northwest Territories, formerly flowed into Harrowby Bay but now discharges into Franklin Bay. The breakthrough shortened the length of the river by nearly 100 km. Three radiocarbon dates for driftwood stranded about 10 m above sea level along the old Horton River channel and one radiocarbon date for a driftwood log found 6 m above sea level near the present mouth suggest a breakthrough date at about A.D. 1800. Since breakthrough, fan-deltas from tributary creeks have segmented the abandoned channel into several large oxbow lakes; permafrost and ice-wedge polygons have grown along parts of the abandoned channel; gelifluction lobes have encroached onto the abandoned channel; lower Horton River and its tributaries have been rejuvenated; and Horton River has built a 30 km^2 delta into the relatively deep water of Franklin Bay. Although the A.D. 1800 date needs further confirmation, it is clear that the site has considerable promise for geomorphic and permafrost process studies in an area of continuous permafrost.

2059 MACKAY, J.R. - 1981
An experiment in lake drainage, Richards Island, Northwest Territories: a progress report; *in* Current Research, Part A, Geol. Surv. Can., Paper 81-1A, pp. 63-68.

In the Tuktoyaktuk Peninsula and Richards Island region, Northwest Territories, some thousands of lakes have drained naturally, either in whole or in part, in the past few thousand years. The present drainage rate is about one lake per year. Most lakes have drained by channel erosion of ice-wedge systems. Since the region lies in the zone of continuous permafrost, lake drainage and permafrost growth have produced a complex three dimensional permafrost distribution. In order to understand better the processes associated with permafrost growth in drained lakes, a lake 600 m long, 300 m wide, and up to 5 m deep was artificially drained by channel flow along an ice-wedge system in order to simulate natural drainage.

Following drainage on 13 August 1978, the outlet has widened by thaw of ice-rich permafrost to produce a greatly oversized canyon similar to many natural channels and indicative of catastrophic drainage. Probing of the lake bottom immediately after drainage showed that the permafrost surface dipped steeply lakeward where water depths had exceeded 1.5 m. Temperature measurements show that in nearshore areas, where permafrost was less than 10 m deep, freeze-through from the lake bottom to permafrost at depth was completed from 1978 to 1980 by both downward and upward freezing. Where permafrost was much deeper (e.g. more than 20 m), only 5 to 6 m of the lake bottom froze from 1978 to 1980. Accurate levelling of numerous lake bottom bench marks 2 to 23 m deep has shown that frozen ground has continued to heave after the temperature was below 0°C.

2060 MACKAY, J.R., and LEWIS, C.P. - 1981
Frost heave at Inuvik, N.W.T.; *Abstract in* Proc. Fourth Can. Permafrost Conf., March 2-6, 1981, Calgary, Alta., pp. 116-117.

2061 MAIR, J.A., and LYONS, J.A. - 1980
Crustal structure and velocity anisotropy beneath the Beaufort Sea; *Can. J. Earth Sci.*, vol. 18, no. 4, pp. 724-741.

Crustal-scale seismic refraction data obtained in the Beaufort Sea during 1976 reveal a 4-5 km thick sedimentary layer overlying an oceanic crust that thickens rapidly as it approaches the continental terrace of Alaska. A synthetic seismogram analysis of multiple reflected, water-wave events indicates that the upper sedimentary layer has a compressional velocity of 1.8 km/s and a shear velocity of about 0.2 km/s. An oceanic layer 2A of 4.3 km/s, a layer 3A of 6.6 km/s, and a layer 3B of 7.6 km/s overlying an anisotropic (3%) upper mantle with a median velocity of 8.3 km/s are interpreted. The direction of maximum upper-mantle velocity appears to be approximately north-south in the area surveyed, suggesting that a rotation of the Northwind Ridge - Chukchi Plateau away from the Barrow - Martin Point sector of Alaska may have occurred.

2062 MANDARINO, J.A., and STURMAN, B.D. - 1976
Kulanite, a new barium iron aluminum phosphate from the Yukon Territory, Canada; *Can. Mineralogist*, vol. 14, pp. 127-131.

Kulanite occurs as blue to green plates and rosette-like aggregates in a sideritic iron-formation in the Big Fish River-Blow River area in the northeastern part of the Yukon Territory. The mineral is triclinic (pseudo-monoclinic) with space group $P\bar{1}$, a 9.032, b 12.119, c 4.936 Å, $\alpha \sim 90^\circ$, $\beta = 100^\circ 23'$, $\gamma \sim 90^\circ$, $Z = 2$. The plates are tabular parallel to $\{\bar{1}01\}$. Hardness is 4. The mineral has two fair to good cleavages parallel to {010} and {100}. The density is 3.91 ± 0.03 g/cm^3 (meas) and 3.92 g/cm^3 (calc). Kulanite is biaxial (+), $\alpha = 1.703$, $\beta = 1.705$, $\gamma = 1.723$, $2V$(meas) = 32°, $2V$(calc) = 38°, the unsymmetrical dispersion is very strong $r >> v$; pleochroism α brownish green, β green. γ very pale brown; orientation, $\simeq \beta$, $\wedge \gamma = -8^\circ$. Chemical analysis gave the formula:

$Ba_{1.00} (Fe^{2+}_{0.94}Mn^{2+}_{0.57}Mg_{0.49}Ca_{0.09}) \Sigma = {}_{2.09}$ $(Al_{1.81}Fe^{3+}_{0.17}) \Sigma = {}_{1.98}(PO_4)_{3.02} (OH)_{2.74}$, or $Ba(Fe, Mn,Mg,Ca)_2 (Al,Fe)_2 (PO_4)_3 (OH)_3$. Strongest spacings in the X-ray powder pattern are: 8.84(6)(100), 3.108(10)$(03\bar{1},\bar{2}21)$. 3044(7) $(\bar{1}31)$, 2.927(8)(211), and 2.659Å(7)(311,320).

2063 MANDARINO, J.A., STURMAN, B.D., and CORLETT, M.I. - 1977
Penikisite, the magnesium analogue of kulanite, from Yukon Territory; *Can. Mineralogist*, vol. 15, pp. 393-395.

Penikisite is the magnesium analogue of kulanite and occurs as zones in kulanite-penikisite crystals which are from the northeastern corner of Yukon Territory. In appearance and properties penikisite is very similar to kulanite. The mineral is blue to green, has a hardness of 4, has two fair to good cleavages {010} and {100}, *D*(meas.) 3.79 g/cm^3, *D*(calc.) 3.82 g/cm^3 for $Ba(Mg_{1.01}Fe_{0.83}Ca_{0.16})Al_2(PO_4)_2(OH)_3$. Penikisite is biaxial (+), n_α 1.684, $n\beta$ 1.688, $n\gamma$ 1.705. $2V(\gamma) = 56°$(meas.) and 52°(calc.); *X* grass green, *Y* blue green, *Z* pale pink, absorption $X \sim Y > Z$. The mineral shows asymmetrical dispersion with strong dispersion of the optic axes. $r >> v$. Orientation c: $Z = -6°$, $b \simeq Y$ but ranges from 0° to 19°. Penikisite is triclinic (pseudomonoclinic), space group $P\bar{1}$ or $P1$, a 8.999, b 12.069, c 4.921A, $\alpha \sim 90°$, β 100°31', $\gamma \sim 90°$, $Z = 2$. Strongest lines in the X-ray powder diffraction pattern are: 8.81 (60)(100), 3.094 (100)($\bar{2}21$,031), 3.028(60) ($\bar{1}31$), 2.915(80)(211), 2.684 (60)($\bar{3}11$), and 2.649Å(70)(320).

2064 MANDARINO, J.A., STURMAN, B.D., and CORLETT, M.I. - 1978
Satterlyite, a new hydroxyl-bearing ferrous phosphate from the Big Fish River Area, Yukon Territory; *Can. Mineralogist*, vol. 16, pp. 411-413.

Satterlyite occurs as yellow to brown grains (up to 1x1x40 mm) in nodules in shales along the Big Fish River in northeastern Yukon Territory. It has a hardness of 4½ to 5, no cleavage, a vitreous lustre and a density of 3.68 g/cm^3 (meas.) and 3.60 g/cm^3(calc.). The mineral is uniaxial negative, n_ω 1.721, n_ε 1.719, dichroic in thick grains with ω pale yellow, ε brownish yellow, absorption ε > ω. Satterlyite is hexagonal, space group $P31m$, $P31m$ or $P312$; a 11.361, c 5.041A, $c{:}a = 0.4437$, $V = 563.5$Å^3, $Z = 6$. Strongest lines in the X-ray powder diffraction pattern are: 4.49(50)($10\bar{1}1$), 3.520(70)($20\bar{2}1$), 2.990(40) ($21\bar{3}1$), 2.840(80)($22\bar{4}0$), 2.473(100)($22\bar{4}1$), 1.886(40)($22\bar{4}2$), 1.640(40)($60\bar{6}0$), and 1.447 (60)($51\bar{6}2$,2243), all in Å, for CuK$_\alpha$. The chemical formula of satterlyite is, ideally, $(Fe^{2+}_{1.17}Mg_{0.35}Fe^{3+}_{0.18}H_{0.16}Na_{0.10}Mn_{0.04})_{\varepsilon 2.00}PO_4(OH)$. The mineral, a hexagonal polymorph of wolfeite, is named after Dr. Jack Satterly of the Royal Ontario Museum.

1879 McLAREN, P., BARRIE, W.B., SEMPELS, J.M., SIEFFERT, R.A., TAYLOR, R.B., and THOMSON, D. - 1981.
Coastal Environmental Data from Eastern Lancaster Sound and Northeastern Baffin Island, NWT; *Bed. Inst. Ocean.*, Data Series BI-D-81-1, 283 p.

2065 McLAREN, P., BARRIE, W.B., and SEMPELS, J.M. - 1981
The coastal morphology and sedimentology of Cape Hatt: implications for the Baffin Island oil spill project (BIOS); *in* Current Research, Part B, Geol. Surv. Can., Paper 81-1B, pp. 153-162.

Cape Hatt, a small peninsula that protrudes into Eclipse Sound at the north end of Baffin Island is the site for an experimental oil spill to take place in the summer of 1981. Three small bays are required: one as a control; a second to study the effects of oil spilled on the surface and allowed to impinge the shoreline; and a third to use an oil-dispersant mix for comparison with the oil-only experiment.

The chosen site contains at least 13 bays potentially suitable for the experiments. Analyses of data from baseline studies in 1980 have resulted in selection of 3 suitable bays (bays 9, 10 and 11). Geomorphic and sedimentologic criteria indicate that the processes of winds, waves and ice action are greatest in bay 10 and least in bay 11. On the assumptions that cross-contamination must be minimal and longevity of the oil in the environment is desirable to ensure reasonable and measurable detrimental effects, we suggest that bay 10 should be used for control, bay 11 for the oil-dispersant mix and bay 9 for the oil-only experiments.

2066 McLAREN, P. - 1981
River and Suspended Sediment Discharge into Byam Channel, Queen Elizabeth Islands, Northwest Territories, Canada; *Arctic*, vol. 34, no. 2, pp. 141-146.

During 1974, a stream from a small drainage basin (117 km^2) on the east coast of Melville Island discharged approximately 1.63 x 10^{7}m water containing 7.08 x 10^{7}kg suspended sediment. Because nearby basins show hydrological similarity, these data can be extrapolated to provide an indication of the total suspended sediment discharge into the adjacent channels. The results suggest that much of this sediment is not deposited in the channels; rather it is incorporated into the active delta fronts or possibly transported out of Byam Channel above a pycnocline.

2067 McLAREN, P. - 1981
An interpretation of trends in grain size measures; *J. Sedimentary Petrology*, vol. 51, no. 2, pp. 611-624.

The mean grain size, sorting, and skewness of a sedimentary deposit are dependent on the sediment grain size distribution of its source and the sedimentary processes of i) winnowing (erosion), ii) selective deposition of the grain size distribution in transport, and iii) total deposition of the sediment in transport. If a source sediment undergoes erosion, and the resultant sediment in transport is deposited completely, the deposit must be finer, better sorted, and more negatively skewed than the source. This trend is referred to as Case I. The lag remaining after erosion, on the other hand, must be coarser, better sorted, and more positively skewed (Case II). If sediment in transport undergoes selective deposition, the resultant deposit can either be finer (Case IIIA) or coarser (Case IIIB) than the source, but the sorting will be better and the skew more positive.

Although exceptions to these trends may occur, they suggest that comparison of one sediment must be made with another for the proper identification of the sedimentary process, and therefore it is not possible for a single grain-size distribution to identify the depositional environment. The trends also suggest that the skewness of a grain-size distribution has been widely misinterpreted and implies neither the truncation of one of the tails nor the mixing of more than one mode. Rather, a skewed sediment is the natural result of the sedimentary process.

In a system of related environments, these trends can be used to identify both the probable source and the probable deposit and, by inference, the net sediment transport paths among sedimentary deposits. Such an analysis provides a rapid understanding of the sedimentary processes, identifies patterns of erosion and accretion, and may suggest transport processes.

2068 MIALL, A.D. - 1976
Devonian geology of Banks Island, Arctic Canada, and its bearing on the tectonic development of the circum-Arctic region; *Geol. Soc. American Bull.*, vol. 87, pp. 1599-1608.

New information, predominantly from the subsurface, shows that the Devonian rocks of Banks Island comprise four units: a shelf carbonate formation (Siegenian? to Eifelian), a basin-slope calcareous shale (Emsian to late Givetian), a basinal cherty shale (Emsian to Eifelian), and a predominantly deltaic clastic unit (Givetian to Famennian). Paleogeographic reconstructions show southern Banks Island as part of the stable shelf in Early Devonian time. During Middle Devonian time, subsidence took place, and basinal conditions encroached on the shelf from the north. The deep basin is considered to be part of Hazen Trough, which probably was connected with Richardson Trough of northern Yukon.

Subsequent tectonic events have left the Devonian rocks of Banks Island relatively undisturbed, in comparison with those of the Parry Islands to the north. Evidence of subduction and plate collision - such as strong deformation, the development of orogenic welts, and the production of thick, locally derived clastic wedges - is absent in Banks Island, in contrast to areas such as northern Ellesmere Island and northern Alaska. Therefore, if plate movements did take place in the Arctic during Devonian time, Banks Island may have lain opposite an embayment in the advancing plate, resulting in incomplete suturing, as described by Dewey and Burke. However, no satisfactory hypothesis of plate motion in the Arctic has yet been developed, in spite of many attempts.

2069 MIALL, A.D. - 1979
Mesozoic and Tertiary geology of Banks Island, Arctic Canada; *Geol. Surv. Can.*, Memoir No. 387, 235 p.

More than 80 per cent of the surface area of Banks Island is underlain by Mesozoic and Tertiary rocks, the maximum thickness of which probably does not exceed 3000 m (10 000 ft). The disposition of these strata led to the definition of the term "Banks Island Basin" by Thorsteinsson and Tozer, but gravity and subsurface data show that the basin is divisible into a series of structural lows and highs, including Banks Basin, Big River Basin, Cardwell Basin and Storkerson Uplift. These structural elements have been in existence at least since the Early Cretaceous, as shown by facies and paleocurrent trends.

Post-Paleozoic sedimentation commenced in the Early or Middle Jurassic with the accumulation in Banks Basin of 400 m (1320 ft) of marine silty shale correlated with the Wilkie Point and Mould Bay formations. Most of Valanginian to Barremian time is not represented in the sedimentary record. In the Barremian-Aptian interval, differential uplift of Minto Arch and, probably, Storkerson Uplift caused erosion of coarse, quartz-rich detritus, which was transported into Banks and Cardwell basins by braided and meandering streams. The Isachsen Formation, up to 200 m (660 ft) thick, was the result. A transgression in the Albian inundated the existing topography, and the shales of the Christopher Formation overlap the Isachsen at several localities and lie directly on the Devonian basement. The Christopher Formation ranges from 30 to 460 m (110-1500 ft) thick. It is followed by a regressive unit, the Upper Albian Hassel Formation, which represents a barrier island environment. The Hassel is present only on the margins of Northern Banks Basin where it is up to 50 m (165 ft) thick. Most of the detritus in the formation was derived from the Upper Devonian Melville Island Group.

A major disconformity occurs above the Hassel Formation. Locally, much or all of the Lower Cretaceous succession is absent as a result of post-Albian, pre-Campanian erosion. Sedimentation may, however, have continued with a much shorter break in Big River Basin.

The Kanguk Formation (Upper Cretaceous), ranging from 90 to 380 m (300-1250 ft) in thickness, is a transgressive unit consisting mainly of silty shale. Tuff, bentonite beds and manganese spherulites occur in a distinctive bituminous shale member at the base. Littoral marine sand units comprise lower and upper sand members. It grades upward into the predominantly nonmarine Eureka Sound Formation, of late Maastrichtian to Eocene age. Lowermost beds of Eureka Sound comprise a shale of prodelta origin, but delta lobes, consisting of coarser sediments derived mainly from Devonian rocks, prograded into Banks and Big River basins during the Paleogene. The deltaic successions are characterized by coarsening-upward clastic cycles averaging 7.4 m (24.2 ft) in thickness. The Eureka Sound ranges from 200 to 1200 m (650-3900 ft) thick.

The report-area underwent major fault movements during the Oligocene or early Miocene. Most faults are oriented between north and northeast and displacements are normal. The maximum recorded throw is 900 m (3000 ft) on a fault at Nelson Head, where the Eureka Formation is juxtaposed with the Proterozoic basement. Uplift and erosion, which followed this tectonic activity, resulted in deposition of sand, gravel and clay of the Beaufort Formation during the mid to late Miocene by rivers flowing westward across the report-area. The formation thickens to the west, reaching 260 m (860 ft) in Big River Basin, and several thousands of metres offshore to the west of the report-area. Post-Beaufort events include a gentle structural warping, glaciation, and dissection of the Beaufort surface by erosion during the Quaternary.

Oil and gas prospects are poor in the Mesozoic-Tertiary rocks although good reservoir rocks are present. The best reservoir probably is the Isachsen Formation, but this unit is absent over at least some of the major structural highs, probably because they formed topographically elevated areas during sedimentation. Geochemical results indicate that most or all of the Mesozoic-Tertiary section is immature. Lignitic coals are abundant in the Eureka Sound Formation, but their volume and heat value are estimated to be of little economic interest.

2070 MIALL, A.D. - 1981
Arctic geology on the Shelf; *GEOLOG*, Geol. Assoc. Can. Newsletter, vol. 10, Part 1, pp. 21-29.

2071 MICHEL, F., and FRITZ, P. - 1980
Laboratory and Field Studies to Investigate Isotope Effects Occurring During the Formation of Permafrost; *Energy, Mines & Res.*, Part II, Final Report, Contract OSU79-00064, 139 p.

This report describes the work completed to date on the field laboratory site at Illisarvik in terms of samples collected during May of 1979 and the progress made in analysing these samples. Preliminary interpretations of the data are discussed in relation to their significance in understanding the history of the waters at Illisarvik and in terms of the problem of isotope variations in permafrost waters described previously.

The results of two experimental runs completed at Waterloo are discussed in relation to the naturally occurring isotope variations.

Several samples from the Arctic Islands portion of the Polar Gas pipeline route were obtained and are described. Samples from the Foothill's Alaska Highway route were not available during the term of this contract, but negotations for the release of the core material are continuing. Finally, this report suggests a course along which further work should be directed.

2072 MICHEL, F., and FRITZ, P. - 1981
Laboratory and Field Studies to Investigate Isotope Effects Occurring During the Formation of Permafrost; *Energy, Mines & Res.*, Phase III, Final Report, Contract OSU80-00079, 57 p.

This report describes the work completed on the field laboratory at Illisarvik since the previous report in the spring of 1980. Preliminary interpretations of the data are discussed in relation to their significance in understanding the history of the waters at Illisarvik and in terms of the problem of isotope variations in permafrost waters described previously.

2073 MOORE, P.R. - 1981
Mesozoic stratigraphy in the Blue Mountains and Krieger Mountains, northern Ellesmere Island, Arctic Canada: a preliminary account; *in* Current Research, Part A, Geol. Surv. Can., Paper 81-1A, pp. 95-101.

Five Mesozoic sections in the central part of northern Ellesmere Island are described. Triassic formations thin significantly to the northeast, where shallow-water, nearshore facies are preserved. Shallowing in the more axial parts of the basin occurred in the late Scythian (early Triassic), late Karnian (late Triassic) and Valanginian (early Cretaceous). Truly terrestrial conditions existed only in latest Triassic (Norian-Rhaetian) and Early Cretaceous (late Valanginian to early Aptian) times. Mesozoic sediments were largely deposited in a shallow to marginal marine environment.

New fossil collections indicate a possible Bathonian age, in part, for sediments of the Jurassic Savik Formation.

2074 NARBONNE, G.M., GIBLING, M.R., and JONES, B. - 1977
A possible Eurypterid Burrow from Siluro-Devonian coastal flats of Arctic Canada; *Abstract in* Program of Abstracts, 1977 Eastern Can. Paleontology and Biostratigraphy Seminar, Oct. 21-22, 1977, Univ. Waterloo, p. 10.

Specimens of a large, distinctive and hitherto undescribed trace fossil occur in several Upper Silurian to Lower Devonian formations in the south-central Canadian Arctic Islands. These U-shaped burrows are up to 50 cm long and 12 cm deep. Spreite is absent, and the sedimentary laminae between the arms of the burrow show abundant small-scale folds and micro-thrusts, probably due to biologically induced soft-sediment deformation.

The ichnofossil was formed in coastal flat environments, particularly in the intertidal zone. It has not been found in subtidal or persistently fluvial strata. The unlined nature of the burrows and the fact that many show evidence of collapse suggest that they were temporary structures. Unfavourable environmental conditions probably prompted the burrowing activity, and a subsequent return to more favourable conditions probably induced the animal to vacate its temporary shelter.

The large size of the trace fossil, the similarity of stratigraphic and size distribution of the ichnofossil and eurypterids and the association with arthropod scratch-marks suggest a eurypterid originator.

2075 NARBONNE, G.M., and DIXON, O.A. - 1978
Silurian lithistid sponge bioherms from Arctic Canada; *Abstract in* Abstracts from Programs Toronto '78 Meeting Geol. Assoc. Can., Mineralogical Assoc. Can., and Geol. Soc. America and its assoc. societies, Oct. 23-26, 1978 p. 462.

The Upper Silurian Read Bay Formation on Somerset Island contains the first reported Silurian sponge bioherms. These 10-20m diameter mounds of dense, unbedded, lime mudstone contain on average 35% lithistid sponges which functioned primarily as sediment bafflers and, to a lesser extent, as binders. The bioherms rest on patches of crinoidal wackestone-packstone rich in crinoid holdfasts. Horizontally dipping flank beds of crinoidal wackestone contain a rich fossil assemblage predominantly of corals, brachiopods, solenoporid algae, trilobites and sponges. The bioherms had original topographic relief of about 2m, and grew between wave-base and storm wave-base on a broad carbonate shelf.

The bioherms occur at two stratigraphic levels. The younger ones are composed predominantly of sponges; small concentrations of corals and stromatoporoids occur locally. In the older bioherms sponge-rich lime mudstone passes gradually upwards into wackestone rich in corals, calcareous algae and stromatoporoids, at least partially in response to reduced water depth. The sponge colonization community apparently flourished where high turbidity, low water turbulence and related factors restricted the growth of corals and stromatoporoids.

2076 NARBONNE, G.M., GIBLING, M.R., and JONES, B. - 1979
Polarichnus, a new trace fossil from Siluro-Devonian strata of Arctic Canada; *J. Paleontology*, vol. 53, no. 1, pp. 133-141.

Polarichnus garnierensis n. ichnogen, n. ichnosp., is a distinctive trace fossil from Siluro-Devonian strata of Somerset and Cornwallis Islands. The large U-shaped burrow, up to 50 cm long, 15 cm broad and 10 cm deep was formed by forcible displacement of sediment. The sedimentary laminae between the arms are domed upwards in a distinctive pattern of small-scale asymmetric folds and microthrusts. *Polarichnus* was formed in tidal flat environments, most commonly in the intertidal zone. It has not been found in strata deposited under either subtidal or persistently fluvial conditions.

2077 NARBONNE, G.M. - 1980
Selective preservation of trace fossils in fine-grained limestones from the Upper Silurian of Arctic Canada; *Abstract in* Abstracts with programs, 1980 Annual Meetings, Geol. Soc. America (93rd), Nov. 17-20, 1980, Georgia World Congress Center, Atlanta, Georgia, p. 490.

Ichnocoenoses in the Douro Formation on Somerset and Cornwallis Islands show marked differences in composition and nature of preservation in different subtidal carbonate lithotypes. Trace fossils in planar-bedded calcisiltite were preserved through toponomical processes, both as full reliefs within beds and as semi-reliefs at calcisiltite/shale interfaces. In contrast, trace fossils in rubbly (nodular) calcilutite were preserved through diagenetic processes, chiefly selective dolomitization of burrow fills and selective cementation of open burrow systems, and occur only as full reliefs within nodules. Calcisiltite beds contain diverse ichnocoenoses, whereas rubbly calcilutite contains ichnocoenoses largely restricted to infaunal fodinichnia and domichnia

This distribution of trace fossils does not appear to reflect environmental control, but more probably reflects late diagenetic alteration of the calcilutite. Selective diagenesis did not act uniformly on all traces; it enhanced infaunal burrows, (mainly fodinichnia and domichnia) but had little effect on epifaunal traces (mainly cubichnia and repichnia). Selective dolomitization of trace fossils further reduced the diversity of the calcilutite ichnocoenose by obliterating fine morphological details. Modification of bedding surfaces accompanying pressure solution and the formation of nodules destroyed traces preserved in semi-relief at interfaces. These factors combined to significantly reduce trace fossil diversity in rubbly calcilutite, but were ineffective in calcisiltite in which diverse ichnocoenoses, similar to those in siliciclastic deposits, were preserved.

2078 NARBONNE, G.M. - 1981
Stratigraphy, reef development and trace fossils of the Upper Silurian Douro Formation in the southeastern Canadian Arctic Islands; unpub. Ph.D. thesis, Univ. Ottawa, 259 p.

The Read Bay Formation on Somerset Island, the lower part of member A of the Read Bay Formation on Cornwallis Island, and the Douro Formation on Devon Island represent a single widespread unit which should be termed the Douro Formation throughout these three islands. The Douro Formation is of Late Silurian (Ludlow) age, and consists predominantly of rubbly (nodular) limestone with a shelly fauna dominated by smooth-shelled brachiopods. The presence of argillaceous divisions and coral-rich zones provides two independent, but complementary criteria which can be used to correlate sections of the formation throughout the southeastern Canadian Arctic Islands. The argillaceous detritus was most likely derived from a northerly source area. The Douro Formation was deposited in subtidal shelf environments, probably in warm, tranquil, turbid waters of normal or near-normal marine salinities. On Somerset Island, the Douro Formation is underlain by the Cape Storm/Leopold Formations and is overlain by the Somerset Island Formation; these underlying and overlying units were deposited in tidal flat environments. The two deepest stages of the Douro transgression were characterized by a diverse fossil assemblage and sporadic reefal development, whereas shallower deposits were characterized by abundant intraclasts and rare oolites, oncolites and stromatolites.

The reefs of the Douro Formation are the first reported Silurian sponge reefs. These relatively small (5-35 m in diameter) mound-shaped structures contain, on average, 35% lithistid demosponges. Each reef is underlain by a lens of crinoidal wackestone to grainstone rich in crinoid holdfasts; trepostomate bryozoans, solenoporid algae and rhynchonellid brachiopods are locally common. The main mass of each reef consists of lime mudstone with abundant lithistid sponges. A thin layer of wackestone with abundant tabulate and rugose corals and fewer lithistid sponges, calcareous algae, trepostomate bryozoans and stromatoporoids caps each reef. Reefs are commonly surrounded by irregular haloes of crinoidal debris; the abundance and diversity of all fossil groups decreases regularly with distance from the reef. The Douro Sponge Reefs were relatively low structures, with a maximum topographic relief of about 3 m. Much of the reefal lime mud was transported from inter-reefal areas, but significant quantities were produced on the reefs. Reefs underwent synsedimentary cementation, bioerosion and minor storm erosion. The originally siliceous spicules of the lithistid sponges were dissolved and later infilled with sparry calcite. Fabrics and compositions of sparry calcite in cavities record three generations of meteoric cementation. These sponge reefs formed during a geologic period in which coral faunas were diverse. As a consequence, sponge reefs were much more restricted in environment and distribution than they were during periods of evolutionary decline of corals. The Douro Reefs are similar to some Ordovician, Jurassic and Holocene sponge reefs in that the sponges occurred mainly in colonization communities which were later replaced by coral-rich climax communities.

Upper Silurian strata on Somerset, Cornwallis and Devon Islands contain numerous trace fossils. A *Polarichnus - Bergaueria* association characterizes intertidal limestones and dolostones (Cape Storm and Leopold Formations); a *Fuersichnus - Uchirites* association characterizes subtidal shelf limestones (Douro Formation); and a *Scalarituba* association characterizes basin slope limestones (tongue of the ?Cape Phillips Formation). Features resulting from formational and preservational processes of trace fossils suggest that lime mud substrates were generally firm, whereas substrates composed of silt-sized carbonates ranged from firm to thixotropic. Subtidal planar-bedded calcisiltite exhibits a diverse trace fossil assemblage similar to those reported from bathymetrically-equivalent siliciclastic deposits. In contrast, extensive diagenetic modification in the subtidal rubbly calcilutite resulted in a low diversity assemblage restricted to infaunal feeding and dwelling traces. Although the mineralogic composition of the substrate is probably relatively unimportant in controlling the distribution of trace-making organisms, the greater susceptibility of carbonates to early and late diagenetic processes can significantly affect the nature of their trace fossil assemblages.

2079 NASSICHUK, W.W., and DAVIES, G.R. - 1980
Stratigraphy and Sedimentation of the Otto Fiord Formation - a major Mississippian-Pennsylvanian evaporite of subaqueous origin in the Canadian Arctic Archipelago; *Geol. Surv. Can.*, Bull. no. 286, 87 p.

The Otto Fiord Formation, composed of anhydrite, limestone, shale and sandstone of Late Mississippian to Middle Pennsylvanian age, occurs widely in the interior of the Sverdrup Basin, where its distribution appears to have been influenced by previous or contemporaneous tectonic events. It is overlain by Middle Pennsylvanian to Lower Permian limestone, siltstone and shale of the Hare Fiord Formation, and the two formations combined define the Basinal Clastic and Evaporitic Belt. The Otto Fiord Formation attains a thickness of 420 m in northern Ellesmere Island but is considerably thinner in eastern Axel Heiberg Island. In both of these areas it is exposed in normal stratigraphic successions. Elsewhere in Axel Heiberg Island, and in Ellef Ringnes, Amund Ringnes and Melville islands, it outcrops only where it is exposed in more than 100 evaporitic diapirs. The diapirs have been known for more than two decades but the presence of an active halite core beneath a bedded sulphate cap has been known only since 1972 when an exploratory well, Hoodoo L-41, was drilled southeast of Hoodoo Dome proper on Ellef Ringnes Island.

In this report stratigraphic relationships and depositional environments of the Otto Fiord are described, and interpretations of the early paleogeography and tectono-sedimentary history of the Sverdrup Basin are presented. The Otto Fiord probably was deposited in a subaqueous, hypersaline marine environment. This interpretation comes at a time when the field of evaporite sedimentology is dominated by examples of alleged paleo-sabkhas.

In northern Ellesmere Island the Otto Fiord Formation is abundantly fossiliferous and on the basis of data from ammonoids and foraminifers, including fusulinaceans, rather refined biostratigraphic correlations have been made between circum-Arctic regions and standard Carboniferous successions in Europe and midcontinental North America. Rather marked diachroneities at the top of the Otto Fiord Formation, over relatively short distances in the Hare Fiord area of northern Ellesmere Island, coincide with the development of extensive carbonate mounds at the base of the Hare Fiord Formation. Evaporite deposition may have continued behind structural or carbonate barriers in some areas after normal marine conditions became established in others.

1619 NEAVE, K.G., JUDGE, A.S., and HUNTER, J.A. - 1979
Offshore permafrost distribution in the Beaufort Sea as determined from temperature and seismic observations; *in* Proc. Sym. Permafrost Field Methods, October 3, 1977 and Permafrost Geophysics, October 4, 1977; eds. W.J. Scott and R.J.E. Brown, Nat. Res. Council Tech. Memo. no. 124, pp. 168-182.

2080 NORRIS, D.K. - 1975
Herschel Island and Demarcation Point, Yukon Territory; *Geol. Surv. Can.*, Geology Map 1514A Scale 1:250,000.

2081 O'CONNOR, M.J. & ASSOCIATES LTD. - 1980
Development of a Proposed Model to Account for the Surficial Geology of the Southern Beaufort Sea; *Geol. Surv. Can.*, Contract No. OSC79-00 212 for S. Blasco, vol. 1/2, 128 p., vol. 2/2, 68 plates.

A generalized model of the surficial geology of the southern Beaufort Sea continental shelf has been developed from a review of recent scientific studies conducted mainly by the Geological Survey of Canada. The proposed model consists of three basic geologic units whose individual properties and thicknesses may vary over the shelf.

2082 O'CONNOR, M.J. & ASSOCIATES LTD. - 1981
Reflection Seismic Surveys, Government Data Base, 1970-1980; A report on the southern Beaufort Sea; *Geol. Surv. Can.*, Contract No. 08SC. 23420-0-M531 for S. Blasco, 8 p., 8 maps.

A program was initiated to synthesize all shallow seismic data acquired on behalf of the federal government between 1970 and 1980 in the southern Beaufort Sea. The synthesis was part of an overall plan to gain an increased understanding of the marine environment, and thus provide a technical data base for making regulatory decisions regarding offshore resource exploration and development. Authorization to proceed with the synthesis was granted through Department of Supply and Services.

2083 O'CONNOR, M.J. & ASSOCIATES LTD. - 1981
Distribution of Shallow Permafrost; A report on the southern Beaufort Sea; *Geol. Surv. Can.* Contract No. 08SC.23420-0-M531 for S. Blasco, 72 p.

In 1980 the Geological Survey of Canada, EMR, initiated a synthesis of the geological, geophysical and geotechnical information collected in the southern Beaufort Sea. The present report, which examines some of the available seismic information relative to the distribution and occurrence of shallow acoustic permafrost, forms the fourth in a series of studies designed to address specific components of the synthesis in detail.

Four types of shallow acoustic permafrost (APF) can be recognized on the high resolution reflection records collected by the GSC during the period 1970-1980. These are hummocky APF islands, continuous APF, stratigraphically controlled APF and ice lenses. The presence of a fifth type, massive ice, has not yet been confirmed on any seismic sections, but has been reported in certain GSC drill holes and is suspected to occur in the core of some PLF's.

Both the reflection and refraction data suggest that acoustic permafrost underlies a substantial portion of the continental shelf, especially east of 135° longitude. Marginal ice-bonding may also be present at some locations between the Mackenzie Canyon and the MacAulay Line. The acoustic permafrost comprises two distinct layers. A shallow, somewhat discontinuous, layer extends from the seafloor to a depth of 50 to 90 m below seabottom, depending on the water depth. It appears to be underlain by a non-ice-bonded (NIB) zone, approximately 13 m thick, of unknown origin. Beneath the NIB zone, a thicker, more continuous zone of deep acoustic permafrost is also evident. The lateral distributions of the two layers are not equivalent, although both appear to occur in virtually all water depths.

Most of the shallow acoustic permafrost underlying the nearshore areas is believed to be relic in origin. Shallow APF underlying deeper water has probably formed as a result of the present negative seafloor temperatures. At some locations this modern APF may also be associated with some relic permafrost and the growth on pingo-like-features on the seafloor.

2084 O'CONNOR, M.J. & ASSOCIATES LTD. - 1981
Morphology of the shelf edge; A report on the southern Beaufort Sea; *Geol. Surv. Can.*, Contract No. 08SC.23420-0-M531 for S. Blasco, 70 p.

In 1980 the Geological Survey of Canada, EMR, initiated a synthesis of the geological, geophysical and geotechnical information collected in the southern Beaufort Sea. The present report, which examines the morphology of the continental slope and shelf edge, forms the third in a series of studies designed to address specific components of the synthesis in detail.

Fourteen high resolution seismic profiles across the shelf edge and upper continental slope are interpreted and described. The profiles indicate that the shelf edge morphology is characterized by extension features such as pull-aparts, grabens and en echelon faulting, as well as mud diapirs, folds and a rather abrupt change in acoustic penetration near the break in slope. The continental slope is characterized by a wedge of recent sediments which also exhibit extension features in the upper reaches and compressional folds, plow structures and deformed strata downslope.

It is concluded that shallow mass transport processes which have occurred on the continental slope are principally responsible for the present morphology of both the slope and shelf edge. Rates of movement appear to have been variable, ranging from rapid sliding of the strata en masse to slow syndepositional creep of individual beds. Up to 250 m of displacement have occurred between 135° and 136° longitude in this manner.

Since mass movement processes appear to be active at the present time, they must be considered during engineering design of resource projects located in critical areas. It is recommended that additional studies be carried out to locate these critical areas more precisely and determine the pertinent geotechnical design parameters.

2085 OWENS, E.H., TAYLOR, R.B., MILES, M., and FORBES, D.L. - 1981
Coastal geology mapping: an example from the Sverdrup Lowland, District of Franklin; *in* Current Research, Part B, Geol. Surv. Can., Paper 81-1B, pp. 39-48.

A system for coastal geology mapping is discussed which has been tested at scales ranging from 1:4800 to 1:125 000, in a variety of Canadian coastal environments including the Sverdrup Lowland. The system is compatible with the surficial geology mapping schemes used by the Geological Survey of Canada. Initially, the coast is progressively subdivided into shore units, zones and components which are the building blocks used to define the physical coastal characteristics and a limited number of replicate shore types. Use of standardized codes allows a direct comparison between coasts of different geographic areas. All available coastal information is systematically listed on coding sheets and a summary of the primary coastal elements is shown on the maps using coded descriptors. Also displayed on the maps is the distribution of replicate shore types.

2086 PACKARD, J.J., and DIXON, O.A. - 1981
Marine depositional response to epeirogenesis: the evolution of Upper Silurian platform carbonates on Cornwallis Island; *Abstract in* Third Intern. Sym. Arctic Geology, Can. Soc. Petroleum Geologists, June 28-July 1, 1981 Calgary, Alta. p. 101.

2087 PADGHAM, W.A. - 1981
Mining and mineral exploration, Northwest Territories 1981; *Ind. & Northern Affairs*, internal report, 15 p.

Exploration in the Northwest Territories (N.W.T.) continued at the rapid pace established during the past three or four years. Tables 1 to 6 below summarize the various measures of activity available at present. Expenditures on mineral exploration are difficult to determine for such a vast area because of the large number of projects. Furthermore, there are many 'grass roots' and prospecting programs which are not done on claims or permits and may not result in property acquisition. Expenditures on these are rarely reported.

Estimates of expenditure will vary from around 30 to over 50 million dollars depending on whether or not exploration on mining leases is included and how successful the estimator has been in netting projects not normally reported and in identifying expenditures not needed for assessment credit.

2088 PELLETIER, B.R. - 1979
Review of surficial geology and engineering hazards in the Canadian offshore; *Maritime Sediments*, vol. 15, nos. 2 and 3, August-December, pp. 55-91.

Surficial geological mapping and hydrographic charting is most complete in the Atlantic Provinces offshore including the Gulf of St. Lawrence; secondarily, the British Columbia offshore and the Labrador Shelf and Slope are fairly well mapped and charted. However, the entire Arctic offshore has the poorest geological and hydrographic coverage of all Canadian marine waters, with the exceptions of Hudson Bay, Beaufort Sea-Amundsen Gulf area and Lancaster Sound.

For safe marine operations, environmental information is required on winds, storms, waves, currents, tides and sea ice. This background is complemented by a seabed study designed to obtain grab and dredge samples of sediment or rock; to obtain sediment cores with the vibracorer, and gravity and piston corers; to obtain bedrock cores with the use of the diamond drill; to obtain bathymetric maps by means of sonic surveys in which echograms reveal the topographic profile of the sea-floor, and the side scan sonar give the areal view; to obtain details of bedrock features such as bedding, folds, faults, as well as distinguishing erosional and constructional topographic features all for the purposes of geological mapping; and to carry out visual surveys remotely or directly by means of submersible equipment and vehicles. All these background data and survey results can have direct application to seabed engineering problems.

Potential hazards related to surficial geology in the Canadian offshore affect engineering operations such as drilling, dredging, dumping coastal works, foundations and anchorages, cable lays, and pipelines. These hazards are grouped into five main categories: (1) erosion and sedimentation, (2) Morphology, (3) movement, (4) ground ice, and (5) sediments. A breakdown is given as follows: ice-scour grooves and ridges, current scour and fill, buried river channels, sand waves, megaflutes, sand bars, valleys, fjords, canyons, troughs, thermokarst, pingos, mud diapirs, pockmarks, scarps, terraces, hummocky terrain, slump features, bedding dislocations, faulting, earthquakes, ice layers, ice-bonded sediments, thermal degradation, unstable substrate, hydrocarbons, organic matter, clathrates, hard (sand, boulders, bedrock) substrate, and moraine.

The geologist must provide information and advice on the natural framework, and processes operating in the area; the engineer must appreciate these facts. But the engineer may be unable to re-locate his operational site; therefore, the geologist must present the information in its most complete and truest perspective in order to ensure a secure and successful operation.

2089 PELLETIER, B.R., YORATH, C.J., NORRIS, D.K., and YOUNG, F.G. - 1980
Geology, Beaufort-Mackenzie Basin, District of Mackenzie and Yukon Territory, Parts of N.T.S. Sheets 97, 107, and 117; *Geol. Surv. Can.*, Map 1509A.

2090 POLLARD, W.H., and FRENCH, H.M. - 1980
A first approximation of the volume of ground ice, Richards Island, Pleistocene Mackenzie delta, Northwest Territories, Canada; *Can. Geotech. J.*, vol. 17, no. 4, pp. 509-516.

Using data contained in the *Mackenzie Valley Geotechnical Data Bank* together with data derived from morphometric analyses of topographic maps and air photographs, the volume of ground ice present in the upper 10 m of Richards Island is calculated to be 10.27 km^3. Pore and segregated ice constitute over 80% of the total ice volume. Wedge ice constitutes between 12 and 16% of total ice volume in the upper 4.5 m, and approximately 36% of all excess ice. In the upper 1-2 m, wedge ice may exceed 50% of earth materials. Pingo ice is insignificant in terms of its contribution to total ice volumes. Excess ice constitutes 14% of the upper 10 m of permafrost; it follows that thawing of this layer of permafrost may lead to an average subsidence of 1.4 m.

The results of this study are probably typical of other areas of the Pleistocene Mackenzie delta. There is also general agreement with data obtained from arctic Alaska.

2091 ROBERTSON, B.T. - 1980
Stratigraphic setting of some new and rare phosphate minerals in the Yukon Territory; unpub. M.Sc. thesis, Univ. Saskatchewan. 218 p.

The Big Fish River - Rapid Creek phosphatic iron formation, in the Richardson Mountains, Yukon, is a unique sedimentary deposit of lowermost Albian age. It had an unusual post-depositional history which led to the development of a spectacular phosphate occurrence.

Strata were deposited in an environment without currents but of relatively shallow depth, probably just below storm-wave base. The deposit formed on the west side of the penecontemporaneous Cache Creek High. Fluctuations in sea level, tectonic instability, or a progradational sediment system caused coarsening-upward sequences capped by conglomeratic slump deposits in the lower part of the formation in the Rapid Creek area. The rest of the section in this area represents relatively stable conditions. In the Big Fish River and Boundary Creek areas, differential deposition of autochthonous minerals has resulted in gradational mudstone-shale couplets.

Most rocks of the formation are texturally similar to other phosphate and iron deposits. They are broadly categorized as shale, mudstone, siltstone and sandstone. They are composed of four basic components: pellets and granules, detrital quartz grains, skeletal fragments, and siderite matrix. Mixed phosphate-siderite pellets (as well as granules) and matrix constitute a spectrum from sandstone to mudstone and comprise the major part of the formation.

The rocks were originally composed of detrital quartz and clay minerals and autochthonous siderite, pyrite, and a mixed Ca-Fe-Mg phosphate of uncertain identity. Metamorphism altered the phosphate minerals and remobilized the siderite. In non-pelletal phosphate mudstone, the primary Ca-Fe-Mg phosphate is altered to carbonate-apatite, which occurs together with siderite as pseudomorphs in star-shaped concretionary bodies. In coarser-grained rocks, the primary Ca-Fe-Mg phosphate is altered to satterlyite $(Fe,Mg)_2$ PO_4 (OH)) which in turn is altered to arrojadite $(K(Na,Ca)_5(Fe,Mn,Mg)_{14}Al(OH,F)(PO_4)_{12})$. Gormanite-souzalite $((Fe,Mg)_3(Al,Fe)_4(PO_4)_4(OH)_6 \cdot 2H_2O)$ is a common alteration (or replacement) in both.

The four major epigenetic, fracture-filling mineral associations are categorized by the persistent occurrence or dominance of one or two characteristic elements in one or more minerals. They are related to particular host rocks: Ca-rich association with phosphate mudstone, Ba-rich with conglomeratic slump deposits, Fe-Mg-rich with siderite sandstone, and Na-bearing with phosphate sandstone. Simple mineral associations (three minerals, or fewer) are related to particular host rocks or represent local accumulations of a restricted number of elements.

The mineralization in the Big Fish River and Boundary Creek areas is largely confined to spherulitic recrystallized replacements of ammonites and pelecypods. Moreover, concretionary phosphate nodules are present. The minerals in both comprise pyrite, wolfeite $(Fe,Mg)_2PO_4(OH))$, satterlyite, maricite $(NaFePO_4)$, vivianite-baricite $((Fe,Mg)_3(PO_4)_2 \cdot 8H_2O)$, varulite $((Na,Ca)(Mn,Fe)_2(PO_4)_2)$, and their alteration products.

Nahpoite (Na_2HPO_4), a new mineral which occurs as a white powdery alteration product of maricite in some nodules at Big Fish River, was identified for the first time during this study.

2092 ROBERTSON, P.B., and PLANT, A.G. - 1981
Shock Metamorphism in Sillimanite from the Haughton Impact Structure, Devon Island, Canada; *Contrib Mineral Petrol.*, vol. 78, pp. 12-20.

Clasts of shocked garnet-sillimanite gneisses comprise a minor fraction of the allochthonous breccia at the Haughton impact structure. Refractive indices of the diaplectic and fused components of the gneisses, and reduced specific gravity indicate shock pressures from 35 to 55 ± 5 GPa and effective post-shock temperatures from 500° to 1,000°C in a suite of selected samples.

Sillimanites remain birefringent but display several effects of shock metamorphism. Shock-produced planar features and planar fractures are highly developed; optic axial angle ($2V_\gamma$) increases from near normal (26°) to over 80° within a sample; there is a reduction in optical relief and a development of a pale brown colouring which generally deepens in shade as shock level increases. There is no unambiguous evidence, optically or from X-ray investigation, of a high-pressure Al_2SiO_5 polymorph or breakdown to mullite and silica. The highly shocked sillimanites have anomalous K_2O contents from 0.11% to 0.92%. Potassium appears to substitute for aluminum and, to a lesser degree, for iron while retaining sillimanite stoichiometry, and the amount of substitution generally reflects increased shock level. The source of the contributed potassium is the coexisting shock-fused feldspar glass. The glass of each sample is derived primarily from melted alkali feldspar with a minor and varied admixture from the breakdown of mafic minerals. The glasses are depleted in K_2O, although Na_2O is unaffected, and the extent of depletion can be correlated with the increased K_2O content of the associated sillimanite. The incorporation of potassium in shocked sillimanites is a function of both degree of shock deformation and availability of potassium from other coexisting shocked phases. It is speculated that the brown colouration is a function of ferrous iron content and may reflect post-crater thermal history rather than shock level.

2093 SAVELLE, J.M. - 1979
Sedimentary and faunal facies of the Silurian Read Bay Formation near Creswell Bay, Somerset Island, Arctic Canada; unpub. M.Sc. thesis, Univ. Ottawa, 135 p.

Upper Silurian strata near Creswell Bay, Somerset Island belong to the Cape Storm, Read Bay, and Somerset Island Formations. The succession represents a transgressive-regressive sequence.

The Cape Storm and Somerset Island Formations are composed predominantly of generally unfossiliferous planar-laminated dolomite, sandy dolomite, and sandstone, and represent intertidal-supratidal conditions.

The Read Bay Formation consists predominantly of fossiliferous mottled limestone, and minor rubbly argillaceous, peloidal, bioclastic, and oncolitic limestone, and represents subtidal conditions. The formation is divided into two informal members: a lower member distinguished by predominantly brachiopod faunas, and an upper member by predominantly coral faunas. The lower member is interpreted as representing semi-restricted, lagoonal conditions, whereas the upper member represents more open conditions. Oncolitic limestone or dolomite units containing abundant *Megalomoides* separate the two members, and represent local offshore shoals. The shoals apparently developed parallel to the Boothia Uplift, which may have been a mildly positive topographic feature during the Upper Silurian. This feature, in combination with low lying land masses to the north and east of Somerset Island, may have restricted sea water circulation in the area, causing slightly hypersaline tendencies, as suggested by the high strontium content of the limestones.

Stromatoporoids in the Read Bay and Somerset Island Formations include *Plexodictyon katriense* Nestor, *P. heclae* n.sp., *Diplostroma* sp., *Actinostroma furyi* n.sp., *Actinodictyon neteiliki* n.sp., and *Vicunostachyodes sokolovi* (Riabinin).

2094 SAVELLE, J.M. - 1979
Upper Silurian stromatoporoids from Somerset Island, Arctic Canada; *Can. J. Earth Sci.*, vol. 16, no. 2, pp. 364-372.

Plexodictyon katriense Nestor, *P. heclae* n.sp., *Diplostroma* sp., *Actinostroma furyi* n. sp., *Actinodictyon neteiliki* n.sp. and *Vicinostachyodes sokolovi* (Riabinin) occur in Upper Silurian (middle to late Ludlovian) strata near Creswell Bay, Somerset Island. Faunal and sedimentological evidence suggests the stromatoporoids inhabited predominantly shallow, high energy, near-shore environments.

2095 STURMAN, B.D., and MANDARINO, J.A. - 1976
Barićite, the magnesium analogue of vivianite, from Yukon Territory, Canada; *Can. Mineralogist*, vol. 14, pp. 403-406.

Barićite occurs as plates parallel to {010} up to 12 cm in maximum dimension and up to 5 cm thick in fractures in a sideritic iron formation in the northeastern part of Yukon Territory. Barićite is colorless to pale blue and has a white streak which changes to blue after several days. The lustre is vitreous and is pearly on fresh {010} surfaces. There is one perfect cleavage {010} ; thin cleavage flakes are flexible. Hardness is 1½ to 2; D (meas.) is 2.42 g/cm³, D (calc.) is 2.448 g/cm³. Barićite is biaxial (+), $n\alpha$ 1.554(1), $n\beta$ 1.564(1), $n\gamma$ 1.595(1) (Na), $2V$ 59°(2) (meas.) and 60° (calc.). Dispersion, $r < v$ is weak. $X = b$ and $Z \wedge c$ is +32° (1). The mineral is monoclinic, space group $C2/m$, a 10.075(4), b 13.416(8), c 4.670(4)Å, β 104° 52'(2), $a:b:c = 0.7510:1:0.3481$, V = 610.1(4)Å³, $Z = 2$. The strongest lines in the X-ray powder diffraction pattern are: 6.71(100) (020), 3.196(40) ($\bar{1}31$). 2.956(60) ($\bar{3}11.201$), 2.699(70) (221,041), 2.526(50) (241), and 2.418 (35) ($\bar{4}01$) all in Å for Fe/Mn radiation. The ideal chemical formula of barićite is $(Mg_{1.64}Fe^{+2}_{1.21}Fe^{+3}_{0.15}(PO_4)_2(OH)_{0.15}.7.85H_2O$. TGA gives a simple one-stage weight loss curve. An endothermic peak occurs at 220°C and an exothermic peak occurs at 705°C. The mineral is named in honour of Prof. Dr. Ljudevit Barić of the University of Zagreb.

2096 STURMAN, B.D., MANDARINO, J.A., and CORLETT, M.I. - 1977
Maričite, a sodium iron phosphate, from the Big Fish River Area, Yukon Territory, Canada; *Can. Mineralogist*, vol. 15, pp. 396-398.

Maričite in nodules in sideritic ironstones in the Big Fish River area, Yukon Territory, is colorless, grey, or pale brown, has a white streak, and hardness of 4 to 4½. The measured density is 3.66 g/cm³. There is no cleavage. Maricite is biaxial negative with $2V$ 43½°, $n\alpha$ 1.676, $n\beta$ 1.695, $n\gamma$ 1.698; dispersion weak $r>v$; no pleochroism; orientation, $a=X$, $b=Y$. The mineral is orthorhombic, space group $Pmnb$, a 6.867, b 8.989, c 5.049Å; V 311.7Å³, $Z = 4$. The strongest lines in the X-ray powder pattern (Cu$K\alpha$, Guinier camera) are: 3.705(40)(111), 2.729(90)(220), 2.707(80)(211), 2.574(100)(031), 2.525(30)(002), and 1.853(60)(222). The average of six electron microprobe analyses is Na_2O 16.5, MgO 0.8, CaO 0.0, MnO 3.1, FeO 37.4, P_2O_5 42.5, total 100.3 wt. %. This gives $Na_{0.91}$

$Fe_{0.89}Mn_{0.07}Mg_{0.03}P_{1.02}O_{4.00}$or, ideally, $NaFePO_4$. The name is in honor of Prof. Dr. Luka Maric.

2097 TAYLOR, R.B. - 1980
Beach Thaw Depth and the Effect of Ice-Bonded Sediment on Beach Stability, Canadian Arctic Islands; *in* Proc. Can. Coastal Conf 1980, Apr. 22-24, 1980, Burlington, Ont., pp. 103-121.

Fluctuations in beach thaw were monitored on northern Somerset Island, N.W.T., during 1974 to 1976. The progression of seasonal thaw was similar to that previously reported for other Arctic beaches. Mean annual thaw across gravel beaches was only 50 cm. Beneath the foreshore, the surface of ice-bonded sediment fluctuated in response to changing beach morphology and to changing salinity of the pore water. When exposed, ice-bonded sediment thawed at 10 to 16 cm/day, a rate similar to the initial beach thaw after snowmelt; however, concentrations of high wave energy eroded the ice-bonded sediment 30 to 50 cm/day.

2098 TAYLOR, R.B. - 1980
Coastal environments along the northern shore of Somerset Island, District of Franklin; *in* The Coastline of Canada, Ed. S.B. McCann, Geol. Surv. Can., Paper 80-10, pp. 239-250.

The shores of northern Somerset Island are representative of many coasts in the east-central part of the Canadian Arctic Archipelago. Six coastal environments were distinguished along northern Somerset Island: 1) high rock cliff, 2) low rocky shore with pocket beaches, 3) gravel beach, 4) sand and gravel plain, 5) deltaic, and 6) estuarine. The first four environments were differentiated using morphologic and sedimentologic characteristics which were closely related to the underlying bedrock. The last two environments were differentiated on the basis of processes.

Wide variations in the effects of sea ice and waves on shoreline stability were indicated by observations of coastal processes, both seasonally and geographically, during 1972-1976. Only during 1974 was the shoreline significantly changed by waves. Geographically, the shores west of Cape Rennell were affected more by sea ice whereas the shores farther east were affected by higher energy waves. Beach change was greatest, hence beach stability least, between Cunningham Inlet and Garnier Bay and along the more exposed capes along northwestern Somerset Island.

2099 TAYLOR, R.B. - 1980
Coastal reconnaissance for marine terminal planning in the Sverdrup Basin, N.W.T.; *Geol. Surv. Can.*, Vol. 1, Main Report, Open File No. 693, 150 p.

Baseline coastal information is presented for Cornwall, Cameron, King Christian and south Ellef Ringnes Islands, N.W.T., from which a selection and assessment of potential marine terminal sites is made. Oblique aerial and ground photos of the coasts are displayed in accompanying volumes. Six main morphologic coastal types are distinguished. The sandflat coast is the most common. All of the shores are part of a low wave energy, microtidal environment where the longshore transport of sediment is insignificant. Coastal sediments closely correspond to the weathered products of the underlying bedrock. Coastal morphology and stability are affected primarily by sea ice and fluvial processes; however, eolian and slope processes are locally significant. The shores most sensitive to disturbance are those underlain by ground ice and anchor ice and those of the silt-clay coastal plain which are composed of sediment of high plasticity. Well-drained beach ridge and sandflat coasts are better suited for locating marine terminal facilities. A total of eleven coastal sites are recommended as potential marine terminals. From these, the best potential site is chosen for each of the four islands examined.

2100 TAYLOR, R.B. - 1981
Coastal geology maps, central Sverdrup Basin, Northwest Territories, by Woodward-Clyde Consultants under the direction of R.B. Taylor; *Geol. Surv. Can.*, Open File No. 549, GSC List 887.

Four sets of maps (scale 1:125 000) summarize the physical shoreline characteristics of Lougheed, Cornwall and King Christian islands, south Amund Ellef Ringnes Islands and the Sabine Peninsula, Melville Island. There are two maps in each set, one map displays shore unit boundaries, a summary of their physical characteristics, and the distribution of replicate shore types. Plotted on the second map are: nearshore bathymetry, the direction of longshore sediment transport and sites of sea ridging, plus other relevant field observations. Also included in the file are a volume of coding sheets which contain the detailed physical coastal characteristics of each island listed, and a legend or coding scheme which defines the codes used to describe the coast.

The maps and coding sheets were prepared originally for the Strategic Studies Branch of Transport Canada for the purpose of making a preliminary selection and assessment of potential marine terminals. This open file provides a reference coastal data base for the islands listed above.

2101 THORSTEINSSON, R. - 1980
(with contributions by T.T. Uyeno)
Stratigraphy and conodonts of Upper Silurian and Lower Devonian rocks in the environs of the Boothia Uplift, Canadian Arctic Archipelago, Part 1, Contributions to stratigraphy; *Geol. Surv. Can.*, Bull. 292, ISBN 0-660-10706-6, pp. 1-38.

The cratonic Boothia Uplift constitutes a major geological province in the Canadian Arctic. It is 800 km long and 150 km wide and extends from Boothia Peninsula on the continental mainland to about the geographic centre of the Canadian Arctic Archipelago. Rocks of Precambrian and

Phanerozoic ages are included in the Uplift. The principal crustal movements by which the uplift achieved its present areal extent and many of its present structural characteristics occurred in Late Silurian and Early Devonian times. These movements exerted a profound influence on local sedimentation, effecting complex and diverse facies changes that have necessitated the establishment of different formational successions in rocks of Late Silurian to Early Devonian ages in most of the major islands and Boothia Peninsula that comprise the uplift. Uncertainty has surrounded the ages of several formations within this interval of time, and this has precluded a clear understanding of correlations, as well as the timing and areal extent of the crustal movements that produced the Boothia Uplift.

The present study deals mainly with the litho- and biostratigraphy of Upper Silurian to Lower Devonian rocks in the environs of the Boothia Uplift. It commences with the Upper Silurian Cape Storm Formation which was deposited shortly before the onset of crustal movements in the Boothia Uplift in Paleozoic time and ends with the Lower Devonian Disappointment Bay Formation that lies with angular unconformity on the bevelled and truncated rocks of the uplift, and thus provides a firm upper age limit to principal crustal movements that produced the uplift. Much new information is provided on the ages of the various Upper Silurian to Lower Devonian formations in the environs of the uplift, and this is based largely on the study of conodonts (by T.T. Uyeno) and graptolites. The present study has also indicated a need for revisions to the formational nomenclature of rocks in the report area. The Cape Storm Formation is now recognized in the Cornwallis Island area where its basal part is made up of beds included previously in the Allen Bay Formation while its upper part includes beds assigned previously to the lower part of member A of the Read Bay Formation. The remainder of member A, as defined in Cornwallis Island, is herein assigned to the Douro Formation. Rocks referred to the Read Bay Formation in Somerset and Prince of Wales Islands and Boothia Peninsula, and those formerly included in the lower part of the Read Bay in Devon Island are assigned also to the Douro Formation. The rocks formerly considered as members B and C of the Read Bay Formation are included in a single formation for which the new name Barlow Inlet is proposed, whereas member D, which previously constituted the uppermost part of the Read Bay Formation is raised to the rank of formation and given the name Sophia Lake. The Read Bay Formation is raised to the status of group, and includes in order upward the Douro, Barlow Inlet and Sophia Lake Formations. As so defined, the Read Bay Group is distributed only in the Cornwallis Island area and adjacent parts of Devon Island.

Southern and northern parts of the Boothia Uplift, which are separated by Barrow Strait, are characterized by different deformational histories within the Lake Silurian to Early Devonian interval of time. Diastrophism commenced south of the strait (Somerset and Prince of Wales Islands, and Boothia Peninsula) in the late Ludlovian, whereas north of the strait (Cornwallis Island, northwestern Devon Island, and eastern Bathurst Island), it commenced in the early Lochkovian. From the early Lochkovian to the early Zlichovian, diastrophism appears to have proceeded simultaneously in both parts of the uplift.

2102 TRETTIN, H.P., and BALKWILL, H.R. - 1979 Contributions to the tectonic history of the Innuitian Province, Arctic Canada; *Can. J. Earth Sci.*, vol. 16, no. 3, pp. 748-769.

The Innuitian Tectonic Province contains the record of a Phanerozoic mobile belt in northern Greenland and the Canadian Arctic Archipelago. Two fundamentally different phases in its development were separated by the Devonian-Carboniferous Ellesmerian Orogeny. The first contribution focuses on the early Paleozoic history of a key area, the second summarizes the Carboniferous to Cenozoic history of most of the Canadian part of the province.

(1) The early Paleozoic architecture of the mobile belt is apparent only in Ellesmere Island, where exposures extend from the Canadian Shield through Arctic Platform and Franklinian basin into the Pearya orogenic welt. The Franklinian basin comprised the deep but ensulic Hazen Trough and two unstable shelves bordering it on the northwest and southeast. The northwestern shelf was a site of felsic to intermediate volcanism, mainly in the Ordovician Period. Pearya, a site of granitic plutonism in the Devonian Period, supplied much of the clastic basin fill. Its core consisted of a metamorphic complex, about 1.0Ga old, exposed in basement uplifts in northernmost Ellesmere Island. Both basin and welt essentially formed part of the North American Plate, although rifting, evident from mafic and ultramafic intrusions, probably occurred in Early Devonian (or latest Silurian) time. The history of this part of the province is tentatively interpreted as response to the opening and closure of an ocean, connected with Iapetus, that separated northern Ellesmere Island and Greenland from the sialic crust of the present Lomonosov Ridge and Barents Shelf. The Lomonosov Ridge still seems to be attached to the shelf off northeasternmost Ellesmere Island.

(2) Deep subsidence and filling of Sverdrup Basin dominated the Innuitian region from Early Carboniferous through Late Cretaceous time. Large halokinetic diapirs and mafic dikes and sills intruded axial parts of the basin succession through Mesozoic time. Steep faults along the northwestern margin of the basin are Middle Cretaceous and older. Part of the northwestern rim of Sverdrup Basin sagged in latest Cretaceous time, becoming part of the Arctic continental terrace. In the Late Cretaceous and early Tertiary a system of large grabens developed through the southern part of the Innuitian region, linking Canada Basin with Baffin Bay; about the same time, uplift formed some large arches in the northeastern part of the region. Middle Eocene and older rocks were laterally compressed by a phase of pre-Miocene folding and faulting. Some uplift took place in Oligocene or Miocene time on Axel Heiberg

Island. The distribution of recent earthquakes does not indicate the presence of modern active plate margins.

2103 TRETTIN, H.P., and MAYR, U. - 1981
Preliminary geological map and notes, parts of Otto Fiord and Cape Stallworthy areas, District of Franklin; *Geol. Surv. Can.*, Open File No. 757. GSC List No. 891.

Based on field work in 1975, 1977 and 1980 this map includes remapped portions of the Otto Fiord and Cape Stallworthy areas and a newly mapped part of the Otto Fiord area. The notes explain stratigraphic nomenclature and age assignments on the present map and also changes in age assignment in parts of the Cape Stallworthy and Bukken Fiord areas that have not been remapped.

2104 TRETTIN, H.P., and FRISCH, T.O. - 1981
Preliminary geological map and notes, Yelverton Inlet area, District of Franklin; *Geol. Surv. Can.*, Open File No. 758, GSC List No. 891.

This open file is based on published earlier work and field work in 1975, 1977 and 1980.

2105 TRETTIN, H.P. - 1981
Geology of Precambrian to Devonian rocks, M'Clintock Inlet area, District of Franklin; *Geol. Surv. Can.*, Open File No. 759, GSC List No. 891.

This open file is based on published earlier work and field work in 1977, 1979 and 1980.

2106 TRETTIN, H.P. - 1981
A tennantite deposit in the M'Clintock Inlet area, northern Ellesmere Island, District of Franklin; *in* Current Research, Part A, Geol. Surv. Can., Paper 81-1A, pp. 103-106.

A replacement deposit of zincian tennantite east of M'Clintock Inlet is the first reported metallic mineral deposit in the eugeosynclinal terrane of the Innuitian Orogen. It is too small to be of economic value but could serve as a guide for exploration. Significant features appear to be (1) occurrence in an Upper Ordovician shelf dolostone, deposited fairly close to the northwestern margin of the Hazen Trough, and (2) proximity to a repeatedly active fault zone that locally contains ophiolite slices.

2107 UYENO, T.T. - 1980
Stratigraphy and conodonts of Upper Silurian and Lower Devonian rocks in the environs of the Boothia Uplift, Canadian Arctic Archipelago, Part II, Systematic study of conodonts; *Geol. Surv. Can.*, Bull. 292, ISBN 0-660-10706-6, pp. 39-75.

This work includes the systematic paleontology and illustrations of conodonts of Late Silurian to Early Devonian age from the Allen Bay, Cape Storm, Douro, Barlow Inlet, Sophia Lake, Somerset Island, Peel Sound, Devon Island, and Sutherland River (?) Formations, sampled over a relatively wide area, including Cornwallis, Devon, Ellesmere, Prince of Wales, and Somerset Islands, and the Boothia Peninsula, of the Canadian Arctic Archipelago.

1972 VEILLETTE, J.J., and NIXON, F.M. - 1979
Portable drilling equipment for shallow permafrost sampling; *Geol. Surv. Can.*, Paper 79-21, 35 p.

2108 VILKS, G., WAGNER, F.J.E., and PELLETIER, B.R. - 1979
The Holocene marine environment of the Beaufort Shelf; *Geol. Surv. Can.*, Bull. 303, 43 p.

The marine environment on the Canadian continental shelf of the Beaufort Sea is described on the basis of data on foraminifera, molluscs, and sediments. The fauna and sediment were studied in 659 surface samples, 49 sediment cores, and 80 plankton tows, most of which were collected from CSS HUDSON during the summer of 1970.

The sediments consist mainly of silt and clay from the Mackenzie River. Silt is predominant inshore to the north and east of Mackenzie Delta, sand is the predominant fraction in a few localities on the shelf east of the Delta, and gravel is present only in a small area west of Herschel Island and near Baillie Islands to the east.

In an anticlockwise transport model, the sediment is carried towards the east along the coast and west along the outer shelf. The main regions of deposition are Mackenzie Canyon and its vicinity.

Sea ice and the interaction of runoff and ocean waters are the determining factors of organic production and distribution of species. The occurrence of the planktonic foraminifer *Globorotalia pachyderma* is reduced by several orders of magnitude during winter and is absent from the waters of the inner shelf during both seasons. Two benthonic foraminiferal species demonstrate a distinct preference for watermass properties. *Elphidium clavatum* is predominant in waters that are influenced by the runoff of Mackenzie River; *Islandiella teretis* is predominant in the offshore waters. The molluscan fauna is diverse, but few undisturbed specimens were found in waters deeper than 100 m.

Cores taken from the continental shelf contained only Early to Late Holocene sediments, but deposits of one of the glacial periods may have been recovered from the continental slope. On the basis of core recovery, ^{14}C data, and faunal discontinuities, the rate of sedimentation may be in the order of 3-30 cm/1000 y on the continental shelf, more than 100 cm/1000 y in Mackenzie Canyon, and 20-30 cm/1000 y along the continental margin-upper continental slope at depths greater than 1000 m.

The faunal evidence also indicates that along the continental margin to the north of the delta the extent of sediment slumping has increased during the last 5000 years. During the same period the influence of offshore waters in Mackenzie Canyon has also increased. Because one of the causes for the shoreward eddy in the canyon is the eastward migration of the Mackenzie runoff, it is suggested that the present anticlockwise circulation on the continental shelf has existed for at least the last 5000 years.

The thin layer of the postglacial sediments on the continental shelf to the east of the delta may contain a preserved record of ancient shorelines. Several inner shelf cores contain barren layers below the present fauna and in the lower layers of a number of outer shelf cores the diverse faunas are replaced by the inner shelf-estuarine *Elphidium clavatum*. In addition, some of the well sorted sands contain small numbers of foraminifera with an occasional barren layer. The paucity of preserved foraminiferal tests is in accordance with the view that these sediments are remnants of ancient beaches. Off Baillie Islands the sandy sediments are rich with a diverse foraminiferal and molluscan fauna and contain gravel deposited during the late Holocene. A foraminiferal species *Protelphidium nanum* n. sp. is described. It is a small species occurring at water depth between 24 and 69 m.

2109 VINCENT, J-S. - 1980
Les glaciations quaternaires de l'île de Banks, Arctique Canadien; thèse de doctorat non publiée Univ. de Bruxelles, 248 p.

L'île de Banks, sise à l'extrémité du continent nord-américain, est un désert polaire où une longue suite d'événements quaternaires sont préservés et où les inlandsis venant d'un centre de dispersion laurentidien au sud-est ont atteint au moins à trois reprises leur extension maximale. La plus vieille et la plus puissante Glaciation Banks a submergé toute l'île sauf le nord-ouest. Les mers glacio-isostatiques ω et ε ont précédé l'englaciation tandis que les mers λ, γ et δ et les lacs glaciaires Egina et Storkerson ont existé lors de la déglaciation. Après l'Interglaciaire de Morgan Bluffs, marqué par un climat semblable à celui qui existe aujourd'hui, le sud, l'est et le bassin de la Thomsen ont été ennoyés par les glaces au cours de la Glaciation Thomsen. Les lacs glaciaires Parker et Dissection ont existé dans le nord-est. La Mer β a précédé l'englaciation, tandis que la Mer Big a ennoyé de vastes régions lors de la déglaciation. Suite à l'Interglaciaire, probablement sangamonien, du Cap Collinson, marqué par un climat un peu plus chaud que celui du dernier hypsithermal, des lobes de glace ont empiété sur les régions côtières de l'île, au cours du Stade M'Clure de la Glaciation Amundsen au Wisconsinien inférieur. Les lobes Prince of Wales et Thesiger, émanant du golfe Amundsen, ont respectivement progressé, l'un vers le nord-est dans le détroit du Prince-de-Galles, empiétant sur la côte orientale de l'île, l'autre vers le nord-ouest, empiétant sur la côte sud-ouest de l'île. Au même moment, le Lobe Prince Alfred, émanant du détroit du Vicomte-Melville, a progressé vers l'ouest dans le détroit de M'Clure en empiétant sur la côte nord. Les lacs Sarfarssuk, Cardwell et De Salis ont été retenus au front du Lobe Prince of Wales, les lacs Masik, Rufus et Raddi au front du Lobe Thesiger et les lacs Ballast et Ivitaruk, au front du Lobe Prince Alfred. La Mer α a précédé l'englaciation de la côte sud, tandis que la Mer East Coast a submergé l'est de l'île jusqu'à 120 m, la Mer Meek Point l'ouest jusqu'à 20 m et la Mer Investigator le nord jusqu'à 30 m, lors de la déglaciation. Une moraine a été édifiée sur la côte sud-ouest par l'avancée tardive Sand Hills du Lobe Thesiger. Après une période interstadiaire, l'extrémité nord-est de l'île a été recouverte par le Lobe Viscount Melville émanant du détroit du Vicomte-Melville, lors du Stade Russell de la Glaciation Amundsen au Wisconsinien supérieur, et la côte est a été submergée jusqu'à 25 m par la Mer Schuyter Point. Les sédiments, mis en place au cours de ces événements, sont décrits et nommés et leur stratigraphie est établie. Les limites d'avancée du glacier laurentidien, dans le sud-ouest de l'Archipel arctique, au Wisconsinien inférieur et supérieur, sont suggérées.

2110 VINCENT, J-S. - 1981
L'île de Banks: un paradis pour l'étude des glaciations quaternaires; *GEOS*, vol. 10, no. 1, pp. 18-21, ISSN 0374-3268.

2111 VINCENT, J-S. - 1981
Surficial geology, Banks Island (2 sheets), Northwest Territories; *Geol. Surv. Can.*, Maps 16-1979 and 17-1979, GSC List No. 887.

2112 VINSON, T.E. - 1981
A paleomagnetic study of the Eureka Sound Formation, Strathcona Fiord, Ellesmere Island, Canada; unpub. M.Sc. thesis, Univ. Wisconsin-Milwaukee, 125 p., 1 map.

Paleomagnetism was used to date and correlate the Eureka Sound Formation at Strathcona and Slidre Fiords, Northwest Territories, Canada. This method corroborated and further refined previous findings which used palynmorphs and other more limited vertebrate fossil evidence.

158 oriented samples from 6 measured sections at Strathcona Fiord and 4 oriented samples from a measured section at Slidre Fiord were collected for the paleomagnetic study. By correlating the 6 measured sections at Strathcona Fiord, a composite 3511m. stratigraphic column was obtained. The correlation was based primarily on a geologic map of the 4 informal members of the Eureka Sound Formation at Strathcona Fiord prepared from this study. The lithostratigraphic correlation between Strathcona Fiord and Slidre Fiord samples was based on previous work by Bustin (1977) ard Balkwill and Bustin (1975).

All the samples were AF demagnetized at 300 oe. (some to 650 oe.) to remove the secondary magnetism. The polarity sequence for Strathcona Fiord was correlated with the LaBreque and others (1977) magnetic anomaly scale to date the Eureka Sound Formation. The correlation indicates the base of the Eureka Sound Formation is 80.1 m.y. and the top is approximately 51.5 m.y. at Strathcona Fiord. The base of the Formation is 1-2 m.y. younger at the Slidre Fiord site. These dates generally substantiate and refine biochronologic interpretations for these areas by West and others (in press).

Calculated paleopole directions for the sequence at Strathcona Fiord of 70.3°N and 217.1°E ($k = 2.5$, $\alpha_{95} = 11.2°$, $N = 158$) most likely are compromised by a small remaining magnetic overprint. The paleopole position confirms that Ellesmere Island (Strathcona Fiord) was within the present day Arctic Circle from late Cretaceous-early Eocene time (latitude 72.8°N). Paleontological evidence supports the fact that the Eureka Sound Formation was deposited in a warm, moist temperate climate. To achieve this climate above the Arctic Circle requires either a change in the paleoobliquity or a biologic adaptation to the Arctic light-dark regime. Large scale tectonic movement of Ellesmere Island since late Cretaceous time is not a likely solution to this problem.

2113 WATTS, S. - 1981
Bedrock weathering features in a portion of eastern High Arctic Canada: their nature and significance; *Annals of Glaciology*, vol. 2, pp. 170-175.

Highly-weathered Pre-Cambrian bedrock has been reported from scattered localities across Arctic Canada during the past decade. As part of a study on weathering processes under arid conditions, field studies are reported on similar terrain in the Alexandra Fiord-Cape Herschel area of east-central Ellesmere Island. Features examined and sampled in both near-coastal and upland positions include grus, tor-like forms, weathering pits, and tafoni. Factors influencing their development and preservation are reviewed. Particular emphasis is placed on the influence of bedrock lithology and mineralogy (in this case, hornblende content) on the intensity of physical disintegration under cold arid conditions. Chemical analyses and petrographic data are presented in support of this observation. Preservation of certain remnant weathering features in upland summit areas under cold-based glacial ice is postulated.

2114 WATTS, S.H. - 1981
Near-coastal and incipient weathering features in the Cape Herschel - Alexandra Fiord area, Ellesmere Island, District of Franklin; Scientific and Technical Notes; *in* Current Research, Part A; Geol. Surv. Can., Paper 81-1A, pp. 389-394.

On Ellesmere Island along the south coasts of Alexandra Fiord and Buchanan Bay east of the Royal Canadian Mounted Police (RCMP) post are a number of intensely weathered bedrock features. Included are examples of grus accumulations, spalled crusts, exfoliated joint blocks, differentially eroded dykes, and minor incipient weathering pits. Field studies were carried out during July 1979 to document the nature and occurrence of these features as part of a regional assessment of the influence of lithology and topographic position on the processes and products of subaerial weathering under arid arctic conditions.

2115 WEBER, J.R. - 1980/81
Our scientists learn more about the Arctic; *Can. Geographic*, vol. 100, no. 6, pp. 27-31.

2116 WEST, R.M., and DAWSON, M.R. - 1978
Vertebrate Paleontology and the Cenozoic History of the North Atlantic Region; *Polarforschung*, vol. 48, no. 1/2, pp. 103-119.

Fossil vertebrates have been recovered from several lithofacies within the Paleogene Eureka Sound Formation at about 80° north latitude on Ellesmere Island, Canada. Both terrestrial and aquatic vertebrates are present, representing the classes Chondrichthyes, Osteichthyes, Amphibia, Reptilia, Aves and Mammalia. The fossil vertebrates lend support to paleoclimatic interpretations of the Paleogene Arctic as warm, moist and seasonal. The vertebrates come from two distinct levels in the upper part of the Eureka Sound Formation. The fossiliferous rocks are probably Early to Middle Eocene in age, and the faunas appear to postdate faunal separation from Europe. However, geologic data suggest that actual physical contact between Europe and North America via either Spitsbergen or Iceland was not terminated until at least mid-Tertiary.

2117 WEST, R.M., DAWSON, M.R., HICKEY, L.J., and MIALL, A.D. - 1981
Upper Cretaceous and Paleogene Sedimentary Rocks, Eastern Canadian Arctic and Related North Atlantic Areas; *in* Geology of the North Atlantic Borderlands, J.W. Kerr and A.J. Ferguson, eds. Can. Soc. Petroleum Geologists, Memoir 7, pp. 279-298.

Cretaceous to Paleogene sedimentary deposits are widespread across the eastern Canadian Arctic and similar rocks occur also in Greenland and Spitsbergen. These rocks, most of which in Canada are called the Eureka Sound Formation, are the product of closely related regional orogenic events and are markedly similar in lithology and age.

Intensive study in the Bay Fiord region of west-central Ellesmere Island shows that the Eureka Sound Formation there is readily divisible into four informal members. These represent a gradual change in depositional environment from shallow marine to fluvial, although a marine transgression is documented in the middle of the sequence. The lower three members can be traced throughout central Ellesmere Island, which probably is a single depositional basin. The upper member is known to occur only in the Bay Fiord area, and has produced the only terrestrial Paleogene vertebrate fossils known from the Arctic. Areas geographically remote from Bay Fiord are not correlated with the Bay Fiord sequence, except imprecisely, based on fossil plant remains.

The name Eureka Sound Formation has been broadly applied throughout the Canadian Arctic. It is unlikely that all the clastic sedimentary rocks at present included in the formation actually belong to one depositionally continuous unit. However, current usage of the Eureka Sound Formation is clearly understood, and at the present level of understanding the concept of this formation is a suitable one for rocks of a uniform and persistent lithologic facies.

1927 ZOLTAI, S.C., KARASIUK, D.J., and SCOTTER, G.W. - 1980
An natural resource survey of the Thomsen River Area, Banks Island, Northwest Territories; *Parks Can.*, internal report, 153 p.

GEOPHYSICS

1995 ANONYMOUS - 1979
Canadian study to unlock secrets of Arctic seafloor; *Can. Mining J.*, September 1979, pp. 29-32.

1996 ANONYMOUS - 1980
LOREX; *Canada/Today d'aujourd hui*, vol. 11, no. 7, p. 13.

2118 BURGESS, M., ALLEN, V., and JUDGE, A.S. - 1979
Shallow Borehole Temperature Profiles in Permafrost Terrains, Dempster and Alaska Highways 1978; *Energy, Mines & Res. Canada*, Geothermal Service of Canada, Earth Phys. Br., Internal Report No. 79-10, 28 p.

This report presents the first set of temperature profiles obtained in shallow boreholes along the proposed Alaska Highway and Dempster Highway pipeline routes. The boreholes were drilled in the summer of 1978 to conduct geophysical and geotechnical investigations of the soil and permafrost along the routes. The Dempster boreholes, averaging 2.2 m in depth, are situated between Inuvik and Fort McPherson, N.W.T.; the Alaska Highway boreholes, averaging 6.7 m, are between Champagne and Beaver Creek, Yukon.

Permafrost was present in all of the Dempster boreholes. August temperature logs recorded negative temperatures and negative temperature gradients. These gradients are only seasonal, varying due to the penetration of a 50 K annual air temperature variation into a medium of low thermal diffusivity. Temperature logs of the Alaska Highway boreholes, taken in late November, registered negative temperatures in most holes. Permafrost was encountered at all sites along and north of Kluane Lake; none was found in the holes south of the lake.

Monitoring of selected sites, preferably deepened to exceed the depth of zero annual amplitude, for a minimum of two years, is necessary to establish the detailed shallow ground thermal regime at present. Further temperature logs will enable the determination of the mean annual ground temperatures, the amplitude and depth of penetration of the annual variation of surface temperature, the thickness of the active layer, the temperatures within the permafrost and their proximity to 0°C.

2119 BURGESS, M., and RUTLEDGE, L. - 1979
Shallow Borehole Temperature Profiles in Permafrost Terrains, Alaska Highway, July 1979; *Energy, Mines & Res. Canada*, Geothermal Service of Canada, Internal Report No. 79-11, 9 p.

This report presents the second set of temperature profiles obtained in shallow boreholes along the proposed Alaska Highway pipeline route, Yukon Territory. The boreholes were drilled in the summer of 1978 by Foothills Pipeline (Yukon) Ltd. during geotechnical and geophysical investigations of soil and permafrost conditions along the route. In November 1978, 14 of the boreholes preserved for temperature measurements and other borehole geophysical studies were logged for the first time. The thermal data, as well as a description of field methods and a summary of previous permafrost investigations in the Yukon, are compiled in Geothermal Service Internal Report 79-10. Six of the boreholes were then selected in which to monitor the shallow ground thermal regime in greater detail, for which purpose they were revisited in July 1979.

The selected boreholes are located along the shores of and north of Kluane Lake. Temperatures measured in July 1979 are listed in Table 1; permafrost was encountered at all sites. Plots of both the November 1978 and July 1979 temperature logs at each site are included in Figs. 2-7. Diesel levels in all but one drillhole remain high, and continued monitoring at 5 sites should be possible. A third log of each borehole in late April 1980 when ground temperatures reach their lowest values will essentially complete this phase of the pipeline route programme. Emphasis will then switch to detailed observations in six deeper backfilled boreholes in the vicinity of and south of Whitehorse.

2120 BURGESS, M. - 1981
Computer Simulation of the Ground Thermal Regime in the First Year After Drainage of Illisarvik Lake; *Energy, Mines & Res. Canada*, Div. Seismology and Geothermal Studies, Earth Phys. Br., Internal Report No. 81-3, 29 p.

The drainage of lakes by natural means in the Mackenzie Delta has been occurring for several thousand years. Many lakes are at present in a position where they will soon drain by normal geomorphic processes, such as shoreline erosion. In August 1978, Illisarvik Lake (unofficial name), located on Richards Island in the Mackenzie Delta and on the verge of self drainage, was drained artificially. The experiment was undertaken to investigate the growth of permafrost in the western Canadian arctic under naturally occurring field conditions. The overall objectives were to increase the knowledge of permafrost properties and of the processes involved in permafrost growth (redistribution of moisture, ice segregation, rate of frost line penetration and associated heave for example) and thus lead to a better understanding of both natural permafrost processes and problems relating to northern development. By artificially draining a lake predrainage characteristics could be observed to describe the initial physical conditions.

2121 DeLAURIER, J.M., NIBLETT, E.R., PLET, F., and CAMFIELD, P.A. - 1980
Geomagnetic depth sounding over the central Arctic Islands, Canada; *Can. J. Earth Sci.*, vol. 17, no. 12, pp. 1642-1652.

In the spring of 1973, 3 days of simultaneous geomagnetic observations were obtained at six recording sites over the central Arctic Islands. The northern site, Isachsen, displayed the strong suppression of the amplitudes of short-period temporal variations in the vertical component that has been observed at Mould Bay, about 500 km to the southwest. One-dimensional conductivity models suggest high conductivities in the upper crust. Parkinson's arrows for short periods point to the inter-island channels of sea water but for long periods the arrows rotate to point to the deep Arctic Ocean. A large spatial variation of the in-phase correlated Z/H ratios is also observed along a profile across the central Arctic Islands. These ratios peak at the Cameron Island site, which is near the Sverdrup Basin - Franklinian Geosyncline geological boundary. In well-log resistivity data, a conductivity contrast of two orders of magnitude is observed across this margin. Electric currents therefore flow in the conductive sediments of the Sverdrup Basin and in the sea water in the inter-island channels. The electromagnetic response is similar to that near an ocean-continent margin but the peak response occurs "inland" by 300-400 km. Consequently, the margin of the resistive continent is located near the Franklinian - Sverdrup Basin boundary in the central Arctic Islands.

2122 DEY, B., and RICHARDS, J.H. - 1981
The Canadian North: Utility of Remote Sensing for Environmental Monitoring; *Remote Sensing of Environment*, vol. 11, pp. 57-72.

Common notions of the Canadian north are that it is resource rich, underdeveloped, and consists of a variety of fragile environments. Information about the north has been acquired slowly; derived from areally dispersed ground-based observations and aircraft-based intelligence. These methods of data accumulation are poorly adapted to regular repetitive synoptic monitoring of the northern environments. Also, because of demands related to increased economic activity and to the potential of such activity to effect environmental change, there is current urgency to strengthen the information base and institute regular monitoring. Fortunately, a complementary approach applicable to these purposes is available and becoming increasingly useful. Thus, the use of remote sensing observations from spacecraft is discussed in relation to the state of the art and examples of its applications for environmental monitoring in northern Canada.

2020 FORSYTH, D.A., MAIR, J.A., and FRASER, I. - 1979
Crustal structure of the central Sverdrup Basin; *Can. J. Earth Sci.*, vol. 16, no. 8, pp. 1581-1598.

2022 FRENCH, H.M., and SMITH, M.W. - 1980
Sump Studies II - Geothermal Disturbances in Permafrost Terrain Adjacent to Arctic Oil and Gas Wellsites; *Ind. & Northern Affairs*, Northern Affairs Program Environmental Studies No. 14, Cat. R71-19/14-1980E, ISBN 0662-10961-9, 61 p.

2023 FRENCH, H.M., and SMITH, M.W. - 1980
Geothermal disturbance resulting from sump construction and use in permafrost terrain, Arctic Canada; *in* Proc. Sym. Res. on Environmental Fate and Effects of Drilling Fluids and Cuttings, Lake Buena Vista, Florida, January 21-24, 1980, Ind. & Northern Affairs, vol. 1, pp. 139-164.

2029 GAGNÉ, R.M. - 1980
Cruise Report: CCGS, Nahidik, Beaufort Sea 1980; *Geol. Surv. Can.*, internal report, 79 p.

2123 HOBSON, G.D., NEAVE, K.G., MacAULAY, H.A., and HUNTER, J.A. - 1977
Permafrost distribution in the southern Beaufort Sea as determined from seismic measurements; *in* Proc. Sym. Permafrost Geophysics, Oct. 12, 1976, eds. W.J. Scott and R.J.E. Brown, NRC Tech. Mem. No. 119, pp. 91-98.

The existence of ice-bonded permafrost beneath the seabottom of the southern Beaufort Sea was first established by shallow drilling (A.P.O.A. 1970). Seismic methods have been successfully applied to delineate the boundaries of ice-bonded permafrost zones.

2033 HOBSON, G.D. - 1980
The Lomonosov Ridge Experiment: "LOREX'79"; *MUSK-OX*, vol. 26, pp. 51-58.

2124 HOOD, P.J. - 1979
Geophysics and geochemistry in the search for metallic ores; *Geol. Surv. Can.*, Economic Geology Report No. 31, GSC List No. 874.

An up-to-date, comprehensive treatise describing recent advances in geophysical and geochemical techniques applied to the search for metallic ores. It comprises 40 papers, three devoted to overviews, 22 review papers by internationally recognized experts covering in a systematic way recent advances in each of the major disciplines of geophysics and geochemistry, 14 case histories from various parts of the world and a final paper by Chinese authors reviewing recent developments in that country. These papers were presented at an international symposium held in Ottawa in October 1977 and updates material contained in Economic Geology Report 26 (1970).

2125 HUNTER, J.A., BURNS, R.A., GOOD, R.L., and HARRISON, T.E. - 1979
Seabottom seismic refraction array designs; Scientific and Technical Notes, *in* Current Research, Part C; Geol. Surv. Can., Paper 79-1C, pp. 101-102.

During the last few years we have tested seabottom seismic refraction arrays for shallow marine use on continental shelves. We have established that such arrays can be used for compressional velocity determinations, for conversion from travel time to depth scales on high resolution marine reflection records, and for the identification of high velocity anomalies which may result from the presence of ice-bonded permafrost, gas hydrates, boulder beds or consolidated rock within the shallow seabottom sedimentary column.

2126 HUNTER, J.A., MacAULAY, H.A., GAGNÉ, R.M., BURNS, R.A., HARRISON, T.E., and HAWKINS, J.P. - 1980
Hydraulic jet drilling operations at Illisarvik - geological and geophysical logs; *in* Proc. Sym. Permafrost Geophysics (No. 5), November 13 and 14, 1978, eds. W.J. Scott and R.J.E. Brown, NRC Tech. Memo. No. 128, pp. 5-20.

As part of a joint program to study the growth of permafrost in a drained lake bottom a Geological Survey of Canada drilling crew initiated a program at Illisarvik in April, 1978, with the following objectives: 1) to establish a survey grid around the lake; 2) to obtain lake bottom bathymetry on a reconnaissance scale; 3) to install thermistor cables beneath the lake bottom; 4) to obtain geological information on, and samples of, sub-lake bottom materials including estimates of the depth to the top of ice bonded permafrost; and 5) to obtain geophysical logs in ice bonded and non-ice bonded sediments as baseline data for other (seismic) geophysical surveys.

2127 HUNTER, J.A., MacAULAY, H.A., GAGNÉ, R.M., BURNS, R.A., HARRISON, T.E., and HAWKINS, J.P. - 1981
Drained lake experiment for investigation of growth of permafrost at Illisarvik, Northwest Territories - Initial geophysical results; Scientific and Technical Notes; *in* Current Research, Part C; Geol. Surv. Can., Paper 81-1C, pp. 67-76.

A multidisciplinary study of the growth of permafrost and its properties under natural field conditions was proposed in 1973. The natural field conditions would be created by the drainage of some northern lakes which are on the verge of self-drainage.

A lake was selected for draining on Richards Island, Mackenzie Delta area, Northwest Territories, approximately 60 km west of Tuktoyaktuk.

The name Illisarvik was chosen for the lake - an approximation of an Inuvialuktun word meaning "a place of learning".

2128 JUDGE, A.S. - 1979
Environmental Impact Statement for Alaska Gas Pipeline Project: Technical Review of Permafrost - Related Problems; *Energy, Mines & Res. Canada*, Geothermal Service of Canada, Earth Phys. Br., Internal Report No. 79-7, 18 p.

Foothills Pipelines (Yukon) Ltd. made application in 1976 to the National Energy Board for a certificate of public convenience and necessity to construct a natural gas pipeline through the southern Yukon. Foothills Pipelines (South Yukon) Ltd. has prepared an environmental impact statement of the pipeline, now known as the Alaska Highway Gas Pipeline, in response to a series of guidelines issued by an environmental review panel.

Permafrost underlays much of the region through which the proposed pipeline will be built; extensive widespread permafrost is present between Kluane Lake and the Alaskan border and scattered and sporadic permafrost extends to south of Fort Nelson. The role that permafrost and permafrost-related topics will play in the pipeline design is thus readily apparent.

2129 JUDGE, A.S., TAYLOR, A.E., and BURGESS, M. - 1979
Canadian Geothermal Data Collection - Northern Wells 1977-78; *Energy, Mines & Res. Canada*, Earth Phys. Br., Geothermal Series No. 11, 188 p.

The assessment and solution of many problems which may occur in the development of northern regions require a knowledge of subsurface temperatures. This volume supplements four earlier volumes in this series, and it reports new measurements at 30 of the sites listed in the previous volumes and observations from 11 new sites. A total of 98 determinations of permafrost thickness have been reported in the collection to date. Determined thicknesses in the Arctic Islands range from 144 m to 726 m, in the Mackenzie Delta from 0 m to 670 m and in the remainder of the Northern Mainland from 0 m to more than 500 m.

2130 JUDGE, A.S., TAYLOR, A.E., and RUTLEDGE, L. - 1979

Supplement to Canadian Geothermal Data Collection - Northern Wells 1977-78; *Energy, Mines & Res. Canada*, Earth Phys. Br., Open File No. 79-13, 64 p.

This report supplements Canadian Geothermal Data Collection - Northern Wells 1977-1978, reporting subsurface temperature data collected between August, 1978 and July, 1979 from wells of total depth greater than 125 m. New measurements are reported at 13 of the sites previously listed in the collection, and from one new site.

2131 JUDGE, A.S., BURGESS, M., ALLEN, V., and TAYLOR, A. - 1980
Thermal studies at Illisarvik prior to lake drainage; *in* Proc. Sym. Permafrost Geophysics (No. 5), November 13 and 14, 1978, eds. W.J. Scott and R.J.E. Brown, NRC Tech. Memo. No. 128, pp. 26-34.

Prior to the draining of the lake in the late summer of 1978, spring and summer programs of hydraulic drilling, temperature sensing cable installation and subsequent temperature monitoring outlined the distribution of permafrost both across the lake-bottom and beneath the adjacent land mass. The initial thermal programme forms a part of a long term study of permafrost growth in a drained previously unfrozen lake-bottom providing the initial temperature constraints. In addition it is a detailed investigation of the impact of a northern lake upon the surrounding permafrost terrain.

2132 JUDGE, A., TAYLOR, A., BURGESS, M., and ALLEN, V.,- 1981
Geothermal Investigations at the Illisarvik Drained Lake Site; *Energy, Mines & Res. Canada*, Seismology and Geothermal Studies, Earth Phys. Br., Internal Report No. 81-7, 39 p.

Illisarvik Lake is located 60 km due west of Tuktoyaktuk, Northwest Territories, on a peninsula of Richards Island, Mackenzie Delta. The predrainage lake measured some 300 x 600m, was 45m from the sea coast of its closest point with a mean lake surface 7m above sea level and maximum water depths of 4.5m.

Drilling from the lake ice in the spring of 1978 enabled determination of the predrainage temperature conditions. The lake was drained in August 1978 and subsequently a further series of holes were drilled in the lake-bottom, once it had dried, in the summer of 1979. A total of 24 holes have been drilled to date specifically for thermal studies in the lake and on the immediate shorelines.

Research at the drained lake site in the past year has comprised three major thrusts; a) continued observation of temperature cables as and when convenient access was possible, and incorporation of the results into a computer-accessible data file; b) analysis of the predrainage and immediate post-drainage temperature profiles through the use of computer simulation models; and c) regional studies of permafrost conditions, stability and temperatures in the vicinity of Illisarvik and throughout northern Richards Island.

A summary of the investigations in each of these major areas of research follows.

2133 JUDGE, A.S., TAYLOR, A., BURGESS, M., and ALLEN, V. - 1981
Canadian Geothermal Data Collection - Northern Wells 1978-80; *Energy, Mines & Res. Canada*, Earth Phys. Br., Geothermal Series No. 12, 190 p.

Subsurface temperature data collected between August 1978 and September 1980 from holes of total depth greater than 125 m are reported in this volume. The volume supplements Taylor and Judge (1974, 1975, 1976, 1977) and Judge, Taylor and Burgess (1979), reporting only new sites and old sites where new data are available. The six volumes, hereafter referred to as the collection, present measurements from 32 sites in the Arctic Islands, 40 in the Mackenzie Delta and another 41 sites on the Arctic Mainland.

The object of this series of reports is to make widely available some of the base data necessary in the assessment and solution of many of the problems that may occur in northern development. Most of the data presented are from wells not yet in thermal equilibrium; however, where sufficient data exist, equilibrium conditions have been estimated. A total of 113 determinations of permafrost thickness have been reported in the collection to date. Determined thicknesses in the Arctic Islands range from 143 m to 726 m, in the Mackenzie Delta from 0 m to 663 m and in the remainder of the Northern Mainland from 0 m to more than 500 m.

A brief introduction discusses data acquisition and accuracy, the disturbance to thermal equilibrium by drilling and the determination of equilibrium permafrost thickness. A set of six maps shows the locations of, and the permafrost thickness at, the 113 sites. Data collected since the previous volume is presented in a series of four appendices as tables of measured temperature variation with time, graphs of temperature variations with depth at selected time intervals, tables of the logarithmic temperature return to equilibrium from which equilibrium conditions can be inferred, and graphs showing the rate at which equilibrium temperature is restored as a function of the ratio of drilling time to time since completion of drilling.

2134 JUDGE, A.S., BURGESS, M., TAYLOR, A., and ALLEN, V. - 1981
Ground temperature studies at an Arctic drained lake site; *in* Proc. Specialty Conf., The Northern Community: a Search for a Quality Environment, ed. T.S. Vinson, Amer. Soc. Civil Eng., Seattle, Wash., Apr. 8-10, 1981, pp. 642-658.

In August 1978, Illisarvik lake on Richards Island, Mackenzie Delta, Canada, a lake on the verge of drainage by normal geomorphic processes, was artificially drained in order to investigate the growth of permafrost. A total of 24 boreholes were hydraulically drilled to depths ranging from 15-92 m below lake level and instrumented with temperature cables. Monitoring of ground temperatures beneath the lake and surrounding shorelines prior to drainage enabled the delineation of the size, shape and thermal characteristics of the talik beneath the lake. Detailed temperature profiles in the lake were measured summer and winter and a thermograph installed on the lake bottom of a nearby similar lake. Predrainage thermal conditions will be used to determine the natural equilibrium permafrost distribution and hence the minimum age and the thermal history of the lake. Post drainage temperature monitoring will be used to model the freezeback of the talik, and in cooperation with the University of British Columbia associate the energy balance with surface geomorphic processes.

2135 MacAULAY, H.A. - 1979
The use of hydraulic drilling methods to study offshore bottom permafrost; *in* Proc. Sym. Permafrost Field Methods, October 3, 1977, and Permafrost Geophysics, October 4, 1977, eds. W.J. Scott and R.J.E. Brown, NRC Tech. Memo. No. 124, pp. 25-30.

Hydraulic water-jet drilling has been used extensively for water well drilling in non-permafrost areas and to some extent for shallow drilling in areas of discontinuous permafrost.

A simplified version of the technique was applied to the problem of thermistor cable installation in onshore permafrost. This led to a system designed to drill into the seabottom from the natural platform of winter ice.

2061 MAIR, J.A., and LYONS, J.A. - 1980
Crustal structure and velocity anisotropy beneath the Beaufort Sea; *Can. J. Earth Sci.*, vol. 18, no. 4, pp. 724-741.

2071 MICHEL, F., and FRITZ, P. - 1980
Laboratory and Field Studies to Investigate Isotope Effects Occurring During the Formation of Permafrost; *Energy, Mines & Res. Canada*, Part II, Final Report, Contract OSU79-00064, 139 p.

2072 MICHEL, F., and FRITZ, P. - 1981
Laboratory and Field Studies to Investigate Isotope Effects Occurring During the Formation of Permafrost; *Energy, Mines & Res. Canada*, Phase III, Final Report, Contract OSU80-00079, 57 p.

2081 O'CONNOR, M.J. & ASSOCIATES LTD. - 1980
Development of a Proposed Model to Account for the Surficial Geology of the Southern Beaufort Sea; *Geol. Surv. Can.*, Contract No. OSC79-00 212 for S. Blasco, vol. 1/2, 128 p., vol. 2/2, 68 plates.

2082 O'CONNOR, M.J. & ASSOCIATES LTD. - 1981
Reflection Seismic Surveys, Government Data Base, 1970-1980; A report on the southern Beaufort Sea; *Geol. Surv. Can.*, Contract No. 08SC. 23420-0-M531 for S. Blasco, 8 p., 8 maps.

2083 O'CONNOR, M.J. & ASSOCIATES LTD. - 1981
Distribution of Shallow Permafrost; A report on the southern Beaufort Sea; *Geol. Surv. Can.*, Contract No. 08SC.23420-0-M531 for S. Blasco, 72 p.

2084 O'CONNOR, M.J. & ASSOCIATES LTD. - 1981
Morphology of the shelf edge; A report on the southern Beaufort Sea; *Geol. Surv. Can.*, Contract No. 08SC.23420-0-M531 for S. Blasco, 70 p.

2088 PELLETIER, B.R. - 1979
Review of surficial geology and engineering hazards in the Canadian offshore; *Maritime Sediments*, vol. 15, nos. 2 and 3, August-December, pp. 55-91.

2136 SCOTT, W.J. - 1980
D.C. soundings at Illisarvik prior to drainage; *in* Proc. Sym. Permafrost Geophysics (No. 5), November 13 and 14, 1978, eds. W.J. Scott and R.J.E. Brown, NRC Tech. Memo. No. 128, pp. 21-25.

On 28 April, 1978, two D.C. soundings were made at Illisarvik. The two soundings have a common centre 30 m south and 10 m west of the origin on the lake. The soundings were oriented north-south and east-west on the grid. A Schlumberger array was used for the soundings.

2137 STRANGWAY, D.W., ROSSITER, J.R., and REDMAN, J.D. - 1977
Electromagnetic sounding of ice and permafrost; *Ice*, no. 53, p. 10.

2138 STRANGWAY, D.W. - 1978
The moon, glaciers and permafrost; *GEOS*, Fall, 1978, pp. 2-4.

2139 SWEENEY, J.F. - 1981
Arctic seafloor structure and tectonic evolution; *in* Paleoreconstruction of the Continents, Geodynamics Series, vol. 2, cont. no. 819, pp. 55-64.

The age and present structure of much of the Arctic Basin has remained a mystery largely because of the unusual nature of many features of the seafloor and the lack of adequate geophysical data coverage over most of the ocean. This situation is rapidly changing as the results of several recent Arctic geophysical studies become known. It is now believed the Arctic Basin was created during Early Cretaceous time by the rotation of northern Alaska and the Chukotsk Peninsula away from northern Canada. The rotation may have been initiated by stress produced in the Arctic by the opening of the North Atlantic Ocean. Geophysical and geological evidence from Arctic Canada and north of Alaska suggests that the North American margin of Canada Basin was created by rifting during Early Cretaceous time.

2140 TAYLOR, A.E. - 1981
Thermal regime modelled for drilling and producing in permafrost; *J. Can. Petroleum Tech.*, Apr.-June 1979, pp. 59-66.

The importance of the transient thermal disturbance which develops around wellbores during drilling or production operations has long been recognized. This paper describes a numerical model developed to simulate the transient thermal regime in situations involving cylindrical symmetry. It has been designed to include a phase change with latent heat and hence is especially applicable in geophysical problems of the petroleum industry in permafrost regions.

The program has met success in duplicating annual temperature logs taken over 9 years at a Mackenzie Delta well. Hypothetical examples of drilling and production in permafrost areas are presented and compared to similar activity in more temperate regions. The use of an insulating annulus to reduce thawing in these cases is modelled.

2141 TAYLOR, A., and JUDGE, A. - 1981
Abandonment of Arctic Wells Preserved for Subsurface Temperature Observations: A Status Report; *Energy, Mines & Res. Canada*, Earth Phys. Br., Geothermal Service of Canada, Internal Report No. 81-4, 46 p.

As part of a continuing northern program of the Geothermal Service of the Earth Physics Branch, subsurface temperatures are measured at over 100 sites in the permafrost region of Canada. Data are usually gathered at resource exploration holes in cooperation with the companies involved. By agreement with the regulatory bodies, the Geothermal Service is responsible for certain completion procedures at a number of sites at the end of the science program. Since the mid-1960's, EMR has assumed responsibility to carry out final abandonment procedures at 31 sites; 17 of these are now abandoned and most of the remaining require only a simple bullplug to be placed. Since Geothermal Service Internal Report 76-1 was written, EMR has accepted responsibility to abandon, by the placement of a suitable surface plug, four more wells following completion of the temperature measurements.

This report lists the wells for which EMR is responsible and describes in detail the sites abandoned by Branch personnel or by contract.

2142 TAYLOR, A.E., and JUDGE, A.S. - 1982
Measurement and prediction of permafrost thickness, Arctic Canada; *in* Tech. Papers, 51st Annual Meeting, Soc. Exploration Geophysicists, vol. 6, pp. 3964-3977.

Examples of the prediction of the thermal regime at two sites in Arctic Canada are presented to illustrate the dependence of permafrost thickness on these parameters.

The thickness of frozen, or ice-bonded ground is less than the permafrost thickness due to the depression of the freezing point below 0°C. Ice-bonding may be inferred from geophysical logs that show a different response to frozen and unfrozen material. This paper compares these determinations made by industry to measurements of ice-bonded and permafrost thickness derived from accurate temperature logs.

2143 TAYLOR, A.E., BURGESS, M., JUDGE, A.S., and ALLEN, V.S. - 1982
Canadian Geothermal Data Collection - Northern Wells 1981; *Energy, Mines & Res. Canada*, Earth Phys. Br., Geothermal Series No. 13, 153 p.

The underlying purpose, the history of measurement, the methods of preservation of wells and of data acquisition have all been described at some length. This present volume, plus publications by Taylor and Judge, is believed to contain all available non-confidential subsurface temperature information from holes of depths greater than 125 m within the permafrost regions of Canada. The authors would greatly appreciate receiving any additional information regarding other data known or possessed by the users of this series. Figure 1 shows the locations of all sites of subsurface temperatures available in the collection. Table 1 lists the 36 sites of new data presented in this volume and gives the EPB file number, the coordinates, the elevation, the total depth logged and the measurement techniques used for each.

2112 VINSON, T.E. - 1981
A paleomagnetic study of the Eureka Sound Formation, Strathcona Fiord, Ellesmere Island, Canada; unpub. M.Sc. thesis, Univ. Wisconsin-Milwaukee, 125 p., 1 map.

2144 WALFORD, M.E.R. - 1979
Recent Work, United Kingdom, Arctic areas; *Ice*, News Bull. Intern. Glaciological Soc. no. 61, pp. 9-10.

2145 WALFORD, M.E.R., and HARPER, M.F.L. - 1981
The detailed study of glacier beds using radio-echo techniques; *Geophys. J.R. astr. Soc.*, vol. 67, pp. 487-514.

The paper discusses the phase-sensitive radio-echo sounder as an instrument for probing the detailed shape of a reflecting glacier bed. Results from laboratory model experiments and from field experiments in the Arctic are presented, together with a wave-theoretical background. A useful, simple field technique involves establishing the ray directions of prominent targets detected from the snow surface. Given some computing capability in the field this method can be enhanced by software echo-pulse compression techniques. A different approach is based upon the synthesis of large apertures in the snow surface and the geometry of reflecting surfaces has been measured thus, in field and laboratory model situations. This technique is potentially valuable. It is limited in principle by diffraction and by refraction in ice. In practice it would be prohibitively laborious where thick ice overlies a complicated surface.

GEOPHYSICS

2146 WEBER, J.R. - 1979
The Lomonosov Ridge Experiment: 'Lorex 79'; *EOS*, vol. 60, no. 42, pp. 715-721.

In the spring of 1979 the Department of Energy, Mines and Resources (EMR) undertook a large-scale multidisciplinary project to study the nature and origin of the Lomonosov Ridge. The scientific program was planned and coordinated by the Earth Physics Branch, and the logistic support was provided by the Polar Continental Shelf Project. Scientists from other branches of EMR, from the Department of Fisheries and Oceans (DFO), and from a number of universities in Canada and the U.S.A. took part in the project code named Lorex 79.

2115 WEBER, J.R. - 1980/81
Our scientists learn more about the Arctic; *Can. Geographic*, vol. 100, no. 6, pp. 27-31.

2147 WEBER, J.R. - 1980
Exploring the Arctic Seafloor; *GEOS*, Summer/Eté 1980, pp. 2-7.

A major, multidisciplinary, polar expedition to investigate the nature and origin of the Lomonosov Ridge was conducted by EMR in the spring of 1979. The expedition was code-named LOREX 79, for the Lomonosov Ridge Experiment 1979.

The plan was to establish three stations on the pack ice upstream of the Lomonosov Ridge and let the Transpolar Current, the same current that carried the explorer Fridtjof Nansen's *Fram* across the Arctic Ocean from 1893 to 1896, transport them across the ridge. The hope was that at least one of these stations would drift across its entire width. The timing was critical, as was the initial location of the camps.

GLACIOLOGY

2148 ALEAN, J., and MÜLLER, F. - 1977
Zum Massenhaushalt des Baby Glacier, Axel Heiberg Island, kanadische Hocharktis; *Geographica Helvetica*, Nr. 4, pp. 203-208.

Gletscher stehn in daurndem Massen- und Energie-austausch mit der Umgebung. Die Massenänderungen eines Beobachtungsjahres werden durch die sogenannten Massenhaushaltserhebungen erfaßt, die die Grundlage für das Studium der Wechselbeziehungen zwischen Gletscher und Klima ergeben.

1948 ALT, B.T. - 1979
Investigation of Summer Synoptic Climate Controls of the Mass Balance of Meighen Ice Cap; *Atmosphere-Ocean*, vol. 3, pp. 181-199.

1998 BARSCH, D., and KING, L. - 1979
Die Heidelberg Ellesmere Island Expedition; *Marburger Geographische Schriften*, Proc. Kanada Naturraum und Entwicklungspotential, Eds. C. Schott and A. Pletsch, Marburg/Lahn, vol. 79, pp. 45-56.

2149 BARSCH, D., und STABLEIN, G. - 1980
Gebiet der Heidelberg - Ellesmere - Island Expedition 1978, Northwest Territories, Canada, Geomorphologische Karte 1:25000, Oobloyah Bay.

2150 BERGER, P., und MÜLLER, F. - 1977
Massenhaushalt des Laika Glacier, Coburg Island, kanadischer arktischer Archipel; *Geographica Helvetica*, 32 Jg., Nr. 4, pp. 209-212.

Coburg Island (75°54' N, 79° W) hat eine Lange von etwa 35 km und eine mittlere Breite von 10 km und liegt an der SE-Ecke der Ellesmere Island, an der Mündung des Jones Sound in die Baffin Bay. Der höchste Punkt liegt 820 m u.M. Der sudostliche Teil weist flachere Regionen auf. Die Insel ist stark vergletschert, mit einem Maximum an der NW-Kuste. Dort erreichen die meisten Gletscher das Meer und bilden Eisberge. Das Laika Ice Cap liegt auf einer nach SE gerichteten Halbinsel auf einem runden, an seiner Kulmination 520 m hohen Hochplateau, das leicht nach NE geneigt ist.

Das Klima der Insel wird durch die North Water Polynya stark beeinflußt. Die Durchschnittstemperaturen im Winter (Januar bis Marz) liegen hoher (6 bis 8°C) als bei den benachbarten arktischen Stationen, die nicht durch das offene Wasser der Polynya beeinflußt sind. Auch die Niederschlage sind durch die Polynya um mindestens einen Drittel erhoht, wobei das Maximum im Juli und August auftritt. Da die Insel recht exponiert liegt, wird ihr Klima stark durch die Winde gepragt. Die dominanten Winde blasen von W und NW.

2002 BLAKE, Jr. W. - 1981
Neoglacial fluctuations of glaciers, southeastern Ellesmere Island, Canadian Arctic Archipelago; *Geografiska Annaler*, vol. 63, ser. A., pp. 201-218.

2151 CLARKE, G.K.C., and PATERSON, W.S.B. - 1980
Correspondence: Gerald Schubert and David A. Yuen: Multiple flow states for ice masses: reply to Dr. Fowler's comments; *J. Glaciology*, vol. 25, no. 92, pp. 355-356.

1968 DOAKE, C.S.M., and GORMAN, M. - 1979
Instruments and Methods - Performance of V.H.F. Aerials Close to a Snow Surface; *J. Glaciology*, vol. 22, no. 88, pp. 551-553.

1950 FISHER, D.A., and KOERNER, R.M. - 1981
Some Aspects of Climate Change in the High Arctic During the Holocene as Deduced from Ice Cores; *in* Quaternary Paleoclimate Sym., May 1979, ed. W.C. Mahaney, Geo abstracts, pp. 249-271.

1983 FUSHIMI, H., UEMURA, N., HIGUCHI, K., and IKEGAMI, K. - 1979
Scientific Studies Made during Solo Dogsled Journeys to the North Pole and Across Greenland; *SANGAKU*, J. Japanese Alpine Club, Water Res. Inst., Nagoya Univ., 24 p.

2044 KLASSEN, R.A. - 1981
Aspects of the glacial history of Bylot Island, District of Franklin; *in* Current Research, Part A, Geol. Surv. Can., Paper 81-1A, pp. 317-326.

2152 KOERNER, R.M., and FISHER, D.A. - 1979
Discontinuous flow, ice texture, and dirt content in the basal layers of the Devon Island Ice Cap; *J. Glaciology*, vol. 23, no. 89, pp. 209-222.

Surface-to-bedrock cores obtained with a CRREL thermal drill were taken in 1972 and 1973 from the top of the Devon Island ice cap. There are very pronounced variations in oxygen isotope, micro-particle concentration, and ice texture in the lowermost 5 m of the core. There is a section of isotopically cold, very fine bubbly ice with high micro-particle concentrations between 2.6 and 4.4 m above the bed, considered to represent the Last Ice Age. There is coarse, isotopically warm, clean ice above and below this. For 1.2 m above the bed, the ice is finer again with high micro-particle concentrations but it shows very low bubble concentration and is isotopically the warmest in the core. While the broad variations are common to both cores, in detail there are significant variations despite the fact that the cores were taken only 27 m apart. The variations, when analysed statistically, show that at least 25-30% of the originally continuous profile is missing from each core. Faulting within the near-bedrock ice may be responsible for some of the effect but bubble fabric also gives evidence for irregular non-laminar flow. Because of the strong relationship between crystal size and micro-particle concentrations in the Devon Island cores, it is suggested that the fine-grained nature of dirty layers in the Antarctic and Greenland ice sheets is due to the effect of the dirt inclusions and not of shearing. Steep isotopic gradients in the Devon Island cores are shown to be evidence for possible shearing, which does not effect any change in the crystal texture. Clear ice near the bed is considered a tectonic feature, but the lack of effect on its bed by the ice cap confirms the non-erosional nature of an ice cap frozen to its bed.

In terms of paleoclimatic history, it means that, because of bedrock effects, ice caps of intermediate depth (i.e. <400m) can give continuous information only over the last approximate 5 000 years. Between 5 000 and 10 000 B.P. the time series becomes slightly discontinuous and beyond 10 000 B.P. so discontinuous as to allow only broad climatic inferences to be drawn.

2153 KOERNER, R.M. - 1980
Instantaneous Glacierization, the Rate of Albedo Change, and Feedback Effects at the Beginning of an Ice Age; *Quaternary Res.*, vol. 13, pp. 153-159.

A study of the average annual- and melt-season albedos for the northwest side of the Devon Island Ice Cap shows that there is no step in the average albedo either at the equilibrium or firn line. Similarly, during a period of increasing glacierization there is nowhere any dramatic increase in the average annual- or melt-season albedo with time as the equilibrium line gradually moves downslope. This means that the inception of ice caps and permanent snowfields does not make a significant change to the *rate* of increasing albedo and its associated feedback effects during the same period of glacierization. The extension of the annual period of snowcover generally is much more important to the feedback process (by increasing albedo) than the specific lowering of the equilibrium line. A decreased variability of summer climate, and hence the disappearance of 'anomalously' warm summers, may be an integral part of the glacierizing process.

1942 KOERNER, R.M. - 1980
The problem of lichen-free zones in Arctic Canada; *Arctic & Alpine Res.*, vol. 12, no. 1, pp. 87-94.

1953 KOERNER, R.M. - 1980
Basal ice and paleoclimate; *Abstract in* EOS, vol. 61, no. 5, Abstracts of American Geophys. Union Annual Meeting, p. 50.

1955 KOERNER, R.M., and FISHER, D.A. - 1981
Studying climatic change from Canadian High Arctic ice cores; *SYLLOGEUS*, no. 33, Mus. Nat. Sci., ed. C.R. Harington, pp. 195-218.

1956 KOERNER, R.M., and FISHER, D. - 1981
Update on LNG Transport through Parry Channel - A Climate Forecast; *Polar Continental Shelf Proj.*, internal report, 15 p.

2154 KOERNER, R.M., and FISHER, D. - 1982
Acid snow in the Canadian High Arctic; *Nature*, vol. 295, no. 5845, pp. 137-140.

Increasing levels of acid sulphates in precipitation have recently been discovered in locations as far north as Barrow, Alaska and Bear Island (74°N and 19°E) in the Norwegian Sea. The high sulphur concentrations are attributed to mid-latitude Eurasian sources. We present here acid concentrations (each representing several years of snow accumulation) in ice from part of a 337-m surface-to-bedrock core on northern Ellesmere Island (81°N, 73°W) representing the past 5,000 yr and compare these with significantly higher acid concentrations in snow deposited over the past 25 yr at the same location showing seasonal variations in the concentrations which together constitute a significant trend of increasing acid levels over the past 25 yr.

2155 LORRAIN, R.D., SOUCHEZ, R.A., and TISON, J.L. - 1981
Characteristics of basal ice from two outlet glaciers in the Canadian Arctic - implications for glacier erosion; *in* Current Research, Part B, Geol. Surv. Can., Paper 81-1B, pp. 137-144.

Ice was sampled for chemical and isotopic analyses at the margin of Hook Glacier, Ellesmere Island, and Aktineq Glacier, Bylot Island.

In the section studied at Hook Glacier, striking variations in Cl and Na content occur. This is interpreted as the consequence of recumbent folding which cannot be observed directly.

In the section studied at Aktineq Glacier, the relations between $\delta^{18}O$ and δD values of the samples indicate that striking differences exist among basal ice layers. Some of these layers result from a meltwater refreezing process at the bedrock interface and are located at different heights in section because of recumbent folds and represent only a minor fraction of the basal part. This implies that the whole basal layer is not a result of accretion processes.

Care must thus be taken in evaluating the importance of subglacial erosion by polar outlet glaciers from the thickness of their frontal basal ice and debris layers.

2156 MAAG, H.U., and MULLER, F. - 1978
Beobachtungen an gletschergestauten Seen in der Hocharktis; *Internationale Polartagung*, vol. 11.

2157 MULLER, F., STAUFFER, B., and SCHRIBER, G. - 1975
Isotope measurements and firn stratigraphy on ice caps surrounding the North Water polynya; *in* Proc. Intern. Sym. on Isotopes and Impurities in Snow and Ice; Intern. Assoc. Hydrological Sci., Grenoble, (IAHS No. 118) pp.185-195.

With the aim of assessing the effect of the North Water polynya on the accumulation rates and the thermal regime of the ice masses on the surrounding land, firn samples were collected for ^{18}O and T analyses and firn stratigraphy carried out in pits and on cores to depths of up to 25.6 m at six sites. The preliminary findings indicate that a combined application of the two techniques produces useful results in spite of the homogenizing effect of percolating meltwater in the lower accumulation zones.

1959 MÜLLER, F., BERGER, P., ITO, H., OHMURA, A., SCHROFF, K., and STEFFEN, K. - 1980
Glaciological and Climatological Investigation of the North Water Polynya in Northern Baffin Bay; A report on North Water Project Activities, April 1, 1978 to December 31, 1979, internal report, 123 p. *NOT FOR PUBLICATION*

2158 OMMANNEY, C.S.L., GOODMAN, R.H., and MULLER, F. - 1969
Computer analysis of a glacier inventory of Axel Heiberg Island: Canadian Arctic Archipelago; *Bull. Intern. Assoc. Scientific Hydrology*, vol. XIV, no. 1, pp. 19-28.

Based on the I.H.D. Resolution 1-12 the Commission of Snow and Ice of the I.A.S.H. prepared guide lines for the recording and mapping of the worldwide distribution, water equivalent and related data of 1) the total seasonal snow cover, 2) the sea, lake and river ice, and 3) the perennial ice and snow masses on and beneath the land surfaces. Using the glacier inventory as an example, the problems of standardization and presentation of data are discussed. The operation of a computer program written for a Univac 1108 and the use of its 'control' cards for the analysis of glacier inventory data from a test area in the Canadian Arctic (Axel Heiberg Island) is outlined. The program presently sorts according to characteristics and classification numbers. A range of variables may be chosen and any one variable is averaged, totalled or histogrammed as instructed by the control cards. A brief description of the program is included. The development of a second stage to the program is envisaged.

2159 PATERSON, W.S.B. - 1980
Ice sheets and ice shelves; *in* Dynamics of Snow and Ice Masses, Academic Press, ISBN 0-12-1794 50-4, 78 p.

This chapter deals with ice sheets, ice caps, and ice shelves. The distinction between ice sheets and ice caps, based solely on size, seems arbitrary and serves no useful purpose; we will not adhere strictly to it. The physical principles governing the behavior of all types of glaciers are the same. However, the interest and importance of various aspects of the behavior may differ for the different types.

2160 STEFFEN, K., and MÜLLER, F. - 1977
Local snow distribution on Axel Heiberg Island, Canada: an empirical method of extrapolation from snow course data on White Glacier; *Geographica Helvetica*, vol. 32, no. 4, pp. 195-202.

On the basis of data from seven years of observations from White Glacier, Axel Heiberg Island and the surrounding tundra, the authors have derived an empirical formula for calculating snow depth on the glacier at various elevations from that on the tundra. This formula allows one to acquire mass balance data without the costly and time-consuming procedures of glacier traverses.

2144 WALFORD, M.E.R. - 1979
Recent work, United Kingdom, Arctic areas; *Ice*, News Bull. Intern. Glaciological Soc. no. 61, pp. 9-10.

2145 WALFORD, M.E.R., and HARPER, M.F.L. - 1981
The detailed study of glacier beds using radio-echo techniques; *Geophys. J.R. astr. Soc.*, vol. 67, pp. 487-514.

2161 ANONYMOUS - 1981
A shipwreck Frozen in Time; *SCIENCE NEWS*, vol. 120, September 19, 1981, no. 12.

2162 BATTEN, J. - 1981
JOE MACINNIS and his magnificent obsession; *ENROUTE*, February 1981, pp. 13, 14, 48, 53, and 57.

2163 HOBSON, G.D. - 1980
The Polar Continental Shelf Project; *J. Can. Petroleum Tech.*, October-December, 1981, Arctic Research, pp. 120-123.

2164 HUNTER, G. - 1979
The Dash 7 at the North Pole; *Wardair World*, Summer 1979, pp. 18-20.

2165 MOGG, M.I. - 1980
The 1980 HMS Breadalbane Expedition; *Lighthouse*, no. 22, November 1980, pp. 23-27.

During the 19th century, several attempts were made to find a North West Passage from Europe to the Orient. The Franklin Expedition was the last and the largest of the British Admiralty expeditions and as with all previous expeditions it met with failure. Sir John Franklin and 129 of his men spent the winter of 1845-46 in Erebus and Terror Bays, at the South West tip of Devon Island - a latitude of almost 75° North. In the summer of 1846 the two expedition ships, *HMS EREBUS* and *HMS TERROR*, sailed to the southwest and disappeared. As the years passed, over 40 ships sailed into the ice of the Canadian Arctic in search of Franklin's party. *HMS BREADALBANE* was one of those ships. She was built in Glasgow in 1843, displaced about 430 tons, was 120 feet long, and looked similar to the illustration shown in Figure 1.

2166 PAYNE, D. - 1981
Technology lights up an Arctic shipwreck; *New Scientist*, 15 January 1981, pp. 136-139.

Details of one of the most innovative Arctic expeditions ever were published at this year's meeting of the AAAS. Divers will scan a 128-year-old sunken ship with a range of established and novel imaging devices while scientists probe its surroundings from miniature submarines and diving bells.

HYDROGRAPHY

2167 DAVIES, P. - 1979
Final Field Report, P.C.S.P., Survey, Queens Channel, Project No. 5452-7530; *Can. Hydro. Serv.*, Ocean & Aquatic Sci., Burlington, 31 p.

The project was completed with a total of 12, 787 spot soundings taken.

Two helicopters used the electrically operated ram and spike transducers successfully and collected approximately 50% of the soundings. The season was a complete success and no serious accidents occurred.

The season commenced on February 20, 1979 and ceased on May 8, 1979, a total of 77 days. Four field sheets were completed.

2168 DAVIES, P.V. - 1980
Final Field Report, P.C.S.P. Survey, M'Clintock Channel, Project No. 5452-7324; *Can. Hydro Serv.*, Ocean & Aquatic Sci., Burlington, 38 p.

The first year of a two year project in M'Clintock Channel area commenced on February 21, 1980 and ended April 27, 1980, for a total of 67 days. One field sheet was completed and two others started.

1971 MACDONALD, G. - 1981
The use of Microprocessors for Track Control and Data Verification on Hydrographic Surveys in Canada; *Intern. Hydrographic Review*, vol. LVIII, no. 1, pp. 39-53.

2169 MACDONALD, G., and MEDENDORP, J. - 1981
The Marine Arctic Route Reconnaissance System; *Lighthouse*, no. 24, November 1981, pp. 13, and 15-22.

2088 PELLETIER, B.R. - 1979
Review of surficial geology and engineering hazards in the Canadian offshore; *Maritime Sediments*, vol. 15, nos. 2 and 3, August-December, pp. 55-91.

2170 SANDILANDS, R.W. - 1981
Charting the Beaufort Sea; *Lighthouse*, no. 24, November 1981, pp. 10-12.

2171 STEPHENSON, F. - 1980
Report to the 1980 Athabasca-Mackenzie Waterway Conference; *Can. Hydro. Serv.*, Pacific Region, Internal Report, Ocean & Aquatic Sci., Patricia Bay, 10 p.

HYDROLOGY

2172 ANDERSON, J.C. - 1980
Hydrologic studies in the Mackenzie Delta Region, N.W.T., 1979; *Nat. Hydro. Res. Inst.*, internal report, Env. Can., 49 p.

Hydrologic investigations continued during the 1979 open water season at several watersheds in the taiga and tundra zones of the eastern Mackenzie Delta region, N.W.T. Data were gathered on snowpack water equivalent, river channel and culvert icings, precipitation, air temperature, river discharge, suspended sediment and stream water temperature. Culvert icings to the south of Inuvik were of intermediate magnitude, while to the north, a major river icing recurred on Hans Creek, upstream of the proposed Highway crossing. In both taiga and tundra, late winter snowpack water equivalents were low. Nevertheless, snowmelt produced the largest flood event of the season but peak flows were well below the 50-year design curve values. Relatively low suspended sediment concentrations were measured during the spring flood. A reconnaissance of stream crossings along the Mackenzie and Dempster Highways from Inuvik to the N.W.T.-Yukon border in early May revealed very few problem areas from a hydrologic viewpoint.

2173 ANDERSON, J.C., and GELL, A.W. - 1980
Hans Creek Icing Study: 1979; *Nat. Hydro. Res. Inst.*, internal report, Env. Can., 12 p.

An icing is an accumulation of surface ice formed during the winter by successive freezing of sheets of water that has seeped from the ground, from a river, or from a spring. In May 1979, for the third consecutive year, an icing was observed on lower Hans Creek, N.W.T., just upstream of the proposed Inuvik-Tuktoyaktuk highway crossing (68°52'N; 133°31'W). In late May, there were three distinct zones of icing which encompassed a total area of approximately 11.4 x 10^4 m^2 of the river channel and flood plain. Across the mid-section of the largest zone, ice thickness at eight locations ranged between 0.69 and 1.14 m. At least three icing mounds had formed within the largest icing zone. Growth history of the icing was investigated by observing fracture surfaces on icing mounds and analyzing the crystal structure of ice cores. No overflow ice was observed at the proposed highway crossing in 1979, but the channel was bankful with bottom-fast ice. Prior to its disappearance, the icing caused streamflow diversion and stage elevation during the spring snowmelt flood.

2174 BALLANTYNE, C.K., and McCANN, S.B. - 1980
Short-lived damming of a High-Arctic ice-marginal stream, Ellesmere Island, N.W.T., Canada; *J. Glaciology*, Short Notes, vol. 25, no. 93, pp. 487-491.

The discharge pattern of the "Schei River", which drains a 91.2 km^2 partly glacierized catchment on Ellesmere Island, is dominated by diurnal oscillations reflecting variations in the melt rate of snow and ice in the basin. Superimposed on this diurnal pattern are numerous short-lived discharge fluctuations of irregular periodicity and magnitude. The characteristics of such irregular fluctuations are described and attributed to periodic collapse of the glacier margin and concomitant damming of the main tributary of the "Schei River". Collapse is initiated by the river undercutting the ice margin, and tends to be most frequent in the latter part of the flow season during periods of high discharge. Release of ponded water following the collapse of such ice dams may engender significant flood events.

199* BARSCH, D., and KING, L. - 1979
Die Heidelberg Ellesmere Island Expedition; *Marburger Geographische Schriften*, Proc. Kanada Naturraum und Entwicklungspotential, Eds. C. Schott and A. Pletsch, Marburg/Lahn, vol. 79, pp. 45-56.

2175 BLACHUT, S.P., and McCANN, S.B. - 1981
The behavior of a polar ice-dammed lake, Ellesmere Island, N.W.T., Canada; *Arctic and Alpine Res.*, vol. 13, no. 1, pp. 63-74.

The sudden, partial drainage of a small, deep, isothermal lake ponded against the western margin of the Ellesmere Ice Cap, Ellesmere Island, Canada, was observed in three successive years, 1973 to 1975. The water balance of the lake and the characteristics of the ice dam, monitored in 1974, indicate that barrier flotation was the key factor in the initiation of the jokulhlaups, which occurred as a declining sequence and are probably not a continuing annual event. The total volume of water discharged from the lake and maximum rates of discharge were smaller each year; only the 1973 event was catastrophic in the sense of contributing exceptional volumes of water to the principal river system in the area.

2176 MARSH, P., ROUSE, W.R., and WOO, M-K., - 1981
Evaporation at a High Arctic Site; *J. Applied Meteorology*, vol. 20, no. 6, pp. 713-716.

Recent studies have demonstrated empirical relationships between surface soil moisture and the α' parameter in Priestley and Taylor's version of the combination model. An evaporation study conducted at a high arctic site shows that for gravel and loamy surfaces underlain by permafrost, α' can be expressed as the following function of soil moisture (θ_m):

$$\alpha' = 1.26/(\exp(5.24 - 21.56\theta_m) + 1).$$

Comparison with α' and soil moisture relationships obtained in more temperate latitudes suggests that under drying conditions the evaporation rate will be a response to the particular site characteristics, so that there is no unique relationship between surface soil moisture and evaporation rates.

2177 MARSH, P., and WOO, M-K. - 1981
Snowmelt, glacier melt, and high arctic streamflow regimes; *Can. J. Earth Sci.*, vol. 18, no. 8, pp. 1380-1384.

Most streamflow regimes in the high arctic have been distinguished as nival or proglacial according to the presence or absence of glaciers. A comparison of streamflow in glacierized and non-glacierized basins in a high arctic environment shows that runoff is sustained by various sources of water, including spring snowmelt, the melting of semi-permanent snow banks, glaciers, and rainfall. If spring melt dominates, a simple arctic nival regime results and if this is followed by summer glacier melt, a proglacial regime occurs. In some non-glacierized basins, however, if snowmelt is delayed until mid-summer or if semi-permanent snowbanks are abundant, a proglacial type of runoff pattern may be produced. The overall result is that various combinations of several sources of water will generate a suite of regimes that range from the simple nival to the typical proglacial pattern of flow.

2178 RYDÉN, B.E. - 1979
High Latitude Hydrology On Processes and Water Budgets of Tundra Regions; *Abstract in* Abstracts of Uppsala Dissertations from the Faculty of Science, Univ. Upsala, Sweden, p. 14.

The interdisciplinary tundra investigation of International Biological Programme focused on productivity and environmental factors including, among other controlling factors, hydrological and hydrometeorological conditions. The results on water resources and processes in tundra regions, presented in this thesis, are based on field studies above all in northernmost Sweden and the Canadian Arctic.

Hydrology of tundra areas is characteristic of the extremes of the world. They have the shortest season with liquid precipitation. Rainfall is extremely variable from year to year in the Arctic and the predominance of snow is the most important source of water. The regions receive high amounts of global solar radiation which allows rapid snowmelt. The common characteristic of runoff in tundra areas is that of a concentrated peak at snowmelt. During a period of less than three weeks most small catchments yield 80-90% of yearly total runoff. Melt water movement downward is prevented by permafrost. After snowmelt, most streams carry a limited amount of water that comes from thawing of the active layer and from groundwater storage. The occurrence of glaciers in some areas increases dramatically the supply of water to downstream parts of basins during summer. The cycling of water in tundra is greatly dependent on the soil water regime and the availability to plants is controlled by the annual thaw-freeze processes.

1965 WOO, M-K., and STEER, P. - 1979
Measurement of Trace Rainfall at a High Arctic Site; *Arctic*, vol. 32, no. 1, pp. 80-84.

2179 WOO, M-K. - 1979
Breakup of streams in the Canadian High Arctic; *in* Proc. 36th Eastern Snow Conference, Alexandria Bay, N.Y., June 7-8, 1979, pp. 95-107.

River valleys in the High Arctic are choked with deep snow at the time of breakup. This contrasts with river breakup in more southerly latitudes where ice is a critical factor. In the High Arctic, about three-quarters of annual runoff leaves the basins in two weeks following the initiation of flow, but such peak runoff is confined or obstructed by snow jams.

Recent studies in the vicinity of Resolute, Northwest Territories, show that snow distribution in the valleys strongly influences the sequence of flow events. Initial runoff occurs as slush flow, sheet flow over snow or subsurface flow in the snow. Subsequently, streamflow follows channels carved through the snowpack or tunnels formed inside the snow. In certain valleys, snowdrifts impound substantial amount of water to create a series of ponds. The bursting of these ponds generate flash floods of short duration which rapidly inundate the snow-filled valleys downstream.

Problems associated with these breakup events have implications on the planning of pipeline crossings, culvert design and even the field measurement of flood discharge.

2180 WOO, M-K. - 1979
Snow and ice hydrology of two basins in the Arctic Islands; *Polar Cont. Shelf Proj.*, internal report, 47 p.

Between mid-May and late August 1979, two field studies were conducted on Cornwallis and Devon Islands. The Resolute project continued the research upon the hydrology of a nival regime basin and the breakup processes of an arctic lake. The Eidsbotn project completed a reconnaissance of several glacierized and non-glacierized basins so that a full-scale hydrologic study can be embarked upon in the coming year. Both field projects constitute parts of our continued effort to investigate the hydrologic behaviour of small basins in the Canadian High Arctic.

2181 WOO, M-K., and SAURIOL, J. - 1980
Channel development in snow-filled valleys, Resolute, N.W.T., Canada; *Geografiska Annaler*, vol. 62A, no. 1-2, pp. 37-56.

In the Canadian High Arctic, the bulk of annual streamflow occurs during the period when valleys are choked with snow. A study was carried out near Resolute, Northwest Territories, to examine the manner in which meltwater runoff carves channels in the valley snowpacks. Major factors controlling channel development include snow distribution and snow characteristics which in turn are related to local topography and the prevailing direction of winter snow drift. Channel development begins with a saturation of the valley snowpack, followed by water movement within or on the surface of the snow. Several processes then take place including the ponding and subsequent release of water behind snowdams formed by drifts, the formation and collapse of snow tunnels, the vertical incision and lateral shifting of channels in the snowpack, the abandonment of channels due to flow diversion, and a disintegration and decay of the snow in the valleys. Based on the close relationship between topography, snow accumulation patterns and the recurrence of channel development processes, a qualitative model was formulated to predict the sequence of channel development events.

2182 WOO, M-K. - 1980
Hydrology of a small lake in the Canadian High Arctic; *Arctic & Alpine Res.*, vol. 12, no. 2, pp. 227-235.

A hydrologic study was made on a small lake (area 0.2 km^2) located in continuous permafrost area near Resolute, Northwest Territories, Canada. Depending on the processes that dominate, the hydrology of this lake shows four distinct periods. (1) *Snowmelt period* occurs when the bulk of the meltwater from the basin collects in the lake because the outflow channel is blocked by snowdrift producing large lake level rises and enhancing initial disintegration of the lake ice cover. (2) *Outflow breakup period* lasts for several days during which the lake discharges over 75% of its annual flow. (3) *Summer period* occurs when the lake ice cover rapidly diminishes and evaporation becomes an important source of water loss. In this period, lake evaporation is sustained by rainfall and contribution from the basin slopes. (4) *Winter period* is characterized by the growth and the maintenance of an ice cover which reaches a maximum thickness of 2.4 m.

Over a year, net change in lake storage is small. In terms of the annual water balance, most of the meltwater input discharges as lake outflow while summer rainfall is consumed by evaporation.

2183 WOO, M-K., HERON, R., and STEER, P. - 1981
Catchment hydrology of a High Arctic Lake; *Cold Regions Science & Tech.*, vol. 5, pp. 29-41.

In small lake catchments of the High Arctic, hydrologic processes are highly variable both spatially and temporally, so that single site measurements of hydrologic phenomena are seldom representative of the catchment averages. Throughout spring and summer, snow and ice melts often occur alongside evaporation and runoff from bare ground. The evaluation of various hydrologic quantities therefore is prerequisite upon an incorporation of the changing spatial patterns of the major hydrologic processes.

Through budgeting the water inputs and losses of a typical lake and its catchment, this study demonstrates the dependence of small High Arctic lakes upon their catchments for water supplies. In turn, the lakes modify storage and thus alter the outflow regime of their catchments.

2184 WOO, M-K., and SAURIOL, J. - 1981
Effects of snow jams on fluvial activities in the High Arctic; *Phys. Geography*, vol. 2, no. 1, pp. 83-98.

During break-up in the High Arctic, ice jams are insignificant, but large quantities of snow accumulated in the valleys strongly affect fluvial processes. Near Resolute, Cornwallis Island, many channels were first formed in valley snow drifts and their positions were unstable. Channels carved in the snow can easily accommodate changing discharge by a modification of their width, depth, and velocity. This causes considerable variation in the at-a-station hydraulic geometry relationships.

The availability of sediment is locally restricted by the snow lining along the channels, although some fluvial sediments deposited on the snow revealed that peak flows could entrain very large boulders. Several depositional features observed in the study area also indicated that fluvial activities can extend over a broad zone beyond the confines of the summer channels.

This study suggests that, by increasing discharge, snow jams enhance the erosional power of streams, but by interposing between streamflow and the valley floor, the snow can limit the supply of sediments. Whether the erosional or the protectional tendency dominates will depend upon the snow jam characteristics along various segments of the High Arctic streams.

2185 WOO, M-K., and HERON, R. - 1981
Occurrence of ice layers at the base of High Arctic snowpacks; *Arctic & Alpine Res.*, vol. 13, no. 2, pp. 225-230.

The formation of an ice layer at the base of High Arctic snowpacks is due to a refreezing of the meltwater percolating to the snowground interface. A cold substrate is required to dissipate the latent heat released by the refreezing process, but through such latent heat transfer the warming of the active layer is accelerated.

OCEANOGRAPHY

2186 AAGAARD, K. - 1981
On the deep circulation in the Arctic Ocean; *Deep-Sea Res.*, vol. 28A, no. 3, pp. 251-268.

New measurements show that the deep water of the Arctic Ocean is not simply a uniform body of water but has an internal structure in its hydrography, mixing history and motion. A primary distinction can be made between the upper deep water, less saline than 34.92 to 34.93, which may derive rather directly from the Greenland or Norwegian Sea, and the lower deep water, which has had its salinity augmented within the Arctic Ocean. The relatively sharp interface between the two is centered near 1500 m, but its depth varies considerably.

Both the upper and lower deep waters cross the Lomonosov Ridge. In the vicinity of the Pole, the deep overflow moves diagonally up the ridge in a pulsating manner, with peak speeds exceeding 12 cm s^{-1}. There are indications that oscillations with periods exceeding about two days are bottom-trapped.

Flow in the abyss is generally less than 1 cm s^{-1}, but more energetic episodes with speeds of 2 to 4 cm s^{-1} occur, typically 5 to 10 days apart.

Below the upper few hundred meters, the circulation in both the Eurasian and Canadian basins appears to be cyclonic, and in most areas it is counter to the upper flow regime.

2004 BORNHOLD, B.D., and BONARDI, M. - 1979
Magnetic spherules in Arctic Ocean sediments; *Can. J. Earth Sci.*, vol. 16, no. 9, pp. 1778-1788.

2187 BROOKS, D.J. - 1981
Arctic Oceanographic Survey, Barrow Strait, 1981 Field Report; *Fisheries & Oceans*, internal report, Ocean Sci. & Surveys, Bayfield Lab., Burlington, Field Report Series No. 81-1, 66 p.

As described in this report, long-term monitoring of ocean properties and transport in Barrow Strait was initiated in March 1981 by the Research and Development Division of OSS Central Region (Burlington). This study is being carried out to fill, in part, an information gap that was identified by the Division in 1979, and it is an activity identified with the Working Group on Northwest Passage Oceanography, Subcommittee on Arctic Oceanography (SCAO), of the Canadian Committee on Oceanography. Because year-round shipping through the Northwest Passage seems likely in a few years, both government and industry require development of an oceanographic knowledge base for the region, not only for judging the design and operation of proposed transport systems, but also for addressing safety, environmental protection, and regulatory concerns.

The general aim of the field work described here is to collect information on the magnitude of short- and long-term variations in the physical, chemical, and biological properties of the water in a section of the Northwest Passage. The selected study area, Barrow Strait, is shown in relation to the Canadian Arctic Archipelago in Figure 1, and in detail in Figure 2. The study area includes the entrances to the contiguous waters of McDougall Sound, Peel Sound, and Wellington Channel. The field work utilizes the stable ice cover, and accordingly is scheduled for the late March - early May period. Rotary- and fixed-wing aircraft are used to transport equipment and personnel to on-ice observation sites.

The field work is a combination of regional surveys of water structure and properties, intended to delimit spatial variations, and, at selected sites, of repeated/continuous measurements to identify variability in water structure, chemical and biological properties, and water movements.

The 1981 efforts began with under-ice mooring and recovery trials in March. Because of poor ice conditions in late March, a 29-day flow calibration experiment using twelve moored current meters and eight pressure recorders had to be moved from Barrow Strait to Transect 80 (Stations 81-85) in Peel Sound. However, in April, twin moorings of three current meters each were placed at Station 46 in Barrow Strait for year-long measurement of flow. A total of 81 CTD profile measurements were made for the regional survey of water structure in the network of 56 station locations. A limited number of biological and chemical observations were made, including bottle casts for phytoplankton and nutrient samples, net hauls, and ice bottom scrapings. G-UMPS, a new current profiling device with a gyrocompass to enable direction reading, was successfully field tested at Station 31 and used at several other stations for periods up to 27 hours.

1859 BROWN, R.G.B., and NETTLESHIP, D.N. - 1981
The biological significance of polynyas to arctic colonial seabirds; *in* Polynyas in the Canadian Arctic, Eds. I. Stirling and H. Cleator, Env. Can., Can. Wildl. Serv. Occasional Paper No. 45, pp. 59-65.

1887 PRACH, R.W., BOYD, H., and COOCH, F.G. - 1981
Polynyas and seaducks; *in* Polynyas in the Canadian Arctic, eds. I. Stirling and Holly Cleator , Env. Can., Can. Wildl. Serv. Occasional Paper No. 45, pp. 67-70.

2188 DUNBAR, M., and KEYS, J.E. - 1980
Robeson Channel ice drift and oceanographic measurements 1970-1975; *Defence Res. Establishment Ottawa*, internal report, 150 p.
UNPUBLISHED MANUSCRIPT.

Robeson Channel is the northernmost part of Nares Strait, which separates Greenland from Ellesmere Island and which is one of the main passages connecting the Arctic Ocean with the Atlantic by way of the Canadian Arctic Archipelago - the only such passage that provides a direct route, without the complication of interconnecting channels. It is thus a factor in the water and heat exchange between arctic and temperate regions, as well as a potential navigation route for surface and sub-surface vessels. For these reasons the strait, and Robeson Channel in particular, was chosen as the site of a study of ice drift in restricted channels by the Defence Research Establishment Ottawa in 1970, with the aim of establishing the parts played by wind, current, and tide in the ice movement.

2189 HUNKINS, K. - 1980
Review of the AIDJEX Oceanographic Program; *in* Sea Ice Processes and Models, Proc. Arctic Ice Dynamics Joint Experiment, Intern. Comm. Snow & Ice Sym., ed. R.S. Pritchard, Univ. Wash. Press, Seattle, pp. 34-45.

Sea ice, existing at the interface between ocean and atmosphere in the polar regions, is intimately related to conditions in both the water below and the air above. The AIDJEX oceanographic program was designed to investigate the Arctic Ocean on a space scale of 100 km in the horizontal direction and hundreds of meters in the vertical. It was specifically directed at revealing oceanographic behavior which directly influences the drift of pack ice. This includes the drag of a quiescent stratified ocean, as well as advection of the ice by currents both transient and steady. Data on salinity, temperature, and currents were collected for one year at three stations and for about half a year at a fourth station which broke up. These data, which are still only partially reduced and interpreted, will be an important source of study for a long time. The data set is unique for the Arctic Ocean and probably for any ocean since detailed investigation of the upper layers in open oceans presents considerable difficulty.

2190 LAKE, R.A. - 1978
An oceanographic study of Bridport Inlet, Melville Island, N.W.T., Part I, August 1978; *Fisheries & Oceans*, internal report, Froz. Sea Res. Group, Inst. Ocean Sci., Patricia Bay, 12 p., *UNPUBLISHED MANUSCRIPT*

Bridport Inlet, Melville Island, N.W.T., is the proposed site of a LNG terminal which would operate year-round. Both Petro Can., the proponent of the Project, and the Frozen Sea Research Group (FSRG) of the Government of Canada, Fisheries and Oceans have an interest in the oceanography of the Inlet. A joint project was undertaken by these two parties with FSRG undertaking a series of oceanographic studies during three field trips in August 1978, March 1979 and August 1979. This report describes the work done during the August 1978 field trip and includes the results of this first phase.

2191 LAKE, R.A. - 1979
An oceanographic study of Bridport Inlet, Melville Island, N.W.T., Part II, March 1979; *Fisheries & Oceans*, internal report, Froz. Sea Res. Group, Inst. Ocean Sci., Patricia Bay, 288 p., *UNPUBLISHED MANUSCRIPT*

Work and data obtained in March 1979 is discussed in this report. A final comprehensive report on the physical oceanography of Bridport Inlet will be completed in late 1979.

A Chronology of Events follows which details when various work was carried out in the field. The weather experienced during the trip is shown in part by Figure 1, which gives air temperature and wind speed. The record is notable for its persistent, high winds.

2192 LAKE, R.A. - 1979
An oceanographic study of Bridport Inlet, Melville Island, N.W.T., Part III, March to August 1979; *Fisheries & Oceans*, internal report, Froz. Sea Res. Group, Inst. Ocean Sci., Patricia Bay, 59 p. *UNPUBLISHED MANUSCRIPT*

The present report details data collected by instruments placed at Bridport Inlet in March and recovered during the summer period (July to September). These data are from six recording current meters, a tide gauge and a temperature-conductivity profiling chain. For completeness, and to clarify discussion, some of the material presented in the previous report has been included.

1773 LANGLEBEN, M.P. - 1980
Water Drag Coefficient at AIDJEX, Station Caribou; *in* Sea Ice Processes and Models, Proc. Arctic Ice Dynamics Joint Experiment, Inter. Comm. Snow & Ice Sym., ed. R.S. Pritchard, Univ. Wash. Press, Seattle, pp. 464-471.

2193 LANGLEBEN, M.P. - 1982
Water Drag Coefficient of First-Year Sea Ice; *J. Geophys. Res.*, vol. 87, no. C1, pp. 573-578.

In May 1977, eddy flux measurements of momentum were made with a three-component ultrasonic current meter in the oceanic boundary layer under a first-year floe of fast sea ice in Barrow Strait, N.W.T. By using eddy correlation methods, values of horizontal Reynolds's stress were computed from each of 20 data runs of about 1-hour duration during which the mean current was reasonably steady. A least squares analysis in which water stress was assumed proportional to the square of the mean current yielded a value for the 1-m water drag coefficient of 1.32×10^{-3} with a standard deviation of 0.06×10^{-3}. The diameter of the floe was greater than 1 km and its mean thickness was 128 cm, with a standard deviation of 4 cm and a maximum deviation of 7 cm.

1879 McLAREN, P., BARRIE, W.B., SEMPELS, J.M., SIEFFERT, R.A., TAYLOR, R.B., and THOMSON, D. - 1981
Coastal Environmental Data from Eastern Lancaster Sound and Northeastern Baffin Island, NWT; *Bed. Inst. Ocean.*, Data Series BI-D-81-1, 283 p.

2194 PECK, G.S. - 1979
Arctic Oceanographic Survey - 1979, Field Report; *Fisheries & Oceans*, internal report, Ocean and Aquatic Sci., Central Region Field Report Series No. 79-3, 65 p., *UNPUBLISHED MANUSCRIPT.*

Continuing the program in support of Transport Canada's Energy R&D program on marine transportation of energy commodities, the 1979 Arctic oceanography project concentrated on the Sverdrup Basin. While the primary objective of this project was the collection of current and salinity/temperature data during a representative period of solid ice cover (March-May) to acquire a basic understanding of the physical oceanography in this area, the ultimate aim of our program is to design specific dynamics-related experiments with other agencies (notably AES and industry groups such as APOA and AIEG) to examine motion and deformation in consolidated pack ice. Other applications arising from the studies include: 1) the provision of baseline data which could assist industry in the planning, design and operation of facilities for the exploration and production of hydrocarbon and perhaps mineral finds in the Arctic; 2) the direct use of the baseline data in providing the Department with the expertise to review environmental impact statements; and 3) planning and advising on contingency measures.

Fourteen current meters were moored at seven sites (3 m below the ice and at 50 m depth). Fifty-five CTD profiles were taken at 45 stations while 14 hourly profiles were collected during a 13 hour station at Whitefish.

2195 PECK, G.S. - 1980
Arctic Oceanographic Data Report 1978, Eastern Viscount Melville Sound, Volume II; *Fisheries & Oceans*, internal report, Ocean and Aquatic Sci., Central Region Data Report Series No. 80-1, 163 p. *UNPUBLISHED MANUSCRIPT*.

This is the second of two volumes of data collected by the Central Region, Ocean and Aquatic Sciences in the centre section of the Northwest Passage in March and April 1978. The report is in three parts: current meter data, water level data, and time series (hourly) CTD profiles taken at four locations. Fourteen Aanderaa RCM-4 current meters, modified for Arctic use, were deployed in the project, yielding records from 11 to 43 days in length. A 36-day-long water level record off Stefansson Island was obtained by the Tides and Water Level Section of the Canadian Hydrographic Service, using an Aanderaa tide gauge. CTD data were collected using a Guildline Mark IV CTD system.

2196 PECK, G.S. - 1980
Arctic Oceanographic Data Report 1979, Sverdrup Basin, Volume I; *Fisheries & Oceans*, internal report, Ocean and Aquatic Sci., Central Region Data Report Series No. 80-2, 228 p. *UNPUBLISHED MANUSCRIPT*.

This report contains the CTD profile data collected by Central Region, Ocean and Aquatic Sciences, in the Sverdrup Basin during April, 1979. The data were obtained with a Guildline Mark IV CTD probe deployed from the ice surface by means of a small portable Arctic profiling winch. The recording electronics of the system were contained in the 206B helicopter used for the sampling program. Fourteen additional profiles were taken at hourly intervals at the base camp located at Panarctic Oil Ltd.'s drill site, Whitefish.

2197 PECK, G.S. - 1980
Arctic Oceanographic Data Report 1979, Sverdrup Basin, Volume II; *Fisheries & Oceans*, internal report, Ocean and Aquatic Sci., Central Region Data Report Series No. 80-3, 91 p. *UNPUBLISHED MANUSCRIPT*.

This is the second of two volumes of data collected by the Central Region, Ocean and Aquatic Sciences in the Sverdrup Basin in April, 1979. This report contains the current meter data collected at seven locations. Fourteen current meters, modified for Arctic use, were deployed and yielded records up to 34 days in length. The data have been edited and standard time series analyses run, and preliminary results are presented.

1887 PRACH, R.W., BOYD, H., and COOCH, F.G. - 1981
Polynyas and seaducks; *in* Polynyas in the Canadian Arctic, eds. I. Stirling and Holly Cleator, Env. Can., Can. Wildl. Serv. Occasional Paper No. 45, pp. 67-70.

2171 STEPHENSON, F. - 1980
Report to the 1980 Athabasca-Mackenzie Waterway Conference; *Can. Hydro. Serv.*, Pacific Region, internal report, Ocean & Aquatic Sci., Patricia Bay, 10 p.

1994 STICH, H.F., and DUNN, B.P. - 1980
The Carcinogenic Load of the Environment: Benzo (a)Pyrene in Sediments of Arctic Waters; *Arctic*, vol. 33, no. 4, pp. 807-814.

2198 TAIT, B.J., ST. JACQUES, D.A., and SOLVASON, R.R. - 1980
Winter tidal surveys in Viscount Melville Sound; *Lighthouse*, Special Edition: Proc. 19th Annual Can. Hydro. Conf. March 1980, pp. 80-93.

During the 1977 and 1978 winter field seasons, the Tides, Currents and Water Levels Section, Central Region collected tidal data in Viscount Melville Sound in anticipation of a navigational requirement for this type of information. Aanderaa tide gauges were deployed through the ice and recorded absolute pressure at 15 minute intervals for periods of approximately one month. The pressure records were converted to water levels which were then analysed by standard harmonic techniques.

Computed tidal ranges and time intervals indicate that two distinct tidal signals enter Viscount Melville Sound, one westward through Barrow Strait and one eastward through M'Clure Strait, resulting in a standing oscillation with an antinode approximately in the middle of the Sound. This feature is shown on cotidal charts for the combined tide and for the major semi-diurnal constituents, M2 and S2. The tide is shown to be semi-diurnal throughout the Sound.

2199 TUMMERS, E.L. - 1980
Heat Budgets of the Southeast Beaufort Sea for the years 1974 and 1975; unpub. B.Sc. thesis, Royal Military College of Canada, 204 p.

Comparisons were made of the heat budgets of the Southeast Beaufort Sea for the summer of 1974 (a severe ice year) and the summer of 1975 (a good ice year). Local meteorological data and oceanographic measurements obtained during the Beaufort Sea Project during August of both years were used to obtain estimates of the various heat terms.

Results indicate that: 1) The major heat input to the sea is from absorbed solar radiation; 2) the overall heat contribution from the Mackenzie River is small in comparison to that from solar radiation; 3) the wind patterns in early spring are the major factor in determining the heat content of the water by summer; and 4) the wind patterns later in the spring and summer are the major factor in determining the ice coverage.

From the distribution of heat in the study area, three consistent features were found: a) a warm water core in the vicinity of 70°N, 138°W; b) a core of warmer water north of Atkinson Point associated with the early open-water area; and c) a core of cold water north of Richard's Island.

2200 WONG, C.S., MACDONALD, R.W., BELLEGAY, R.D., and ERICKSON, P. - 1975
Baseline data on chemical oceanography in the southern Beaufort Sea, 1974-5; Beaufort Sea Technical Report No. 14, 51 p.

Two cruises have been made to the Southern Beaufort Sea to collect chemical baseline data. Measurements have been made on hydrocarbon levels, suspended particulates, reactive nutrients, dissolved oxygen, temperature and salinity. The primary objective of the survey was to establish the baseline levels of marine hydrocarbons in the Beaufort Sea drilling area by measuring classes of hydrocarbons and identifying some specific hydrocarbons in seawater, marine sediments, marine organisms, marine mammals and fish. That data has been summarized elsewhere and this companion data report provides the accompanying information on reactive nutrients (silicate, phosphate and nitrate), dissolved oxygen, salinity and temperature.

OIL SPILLS

2065 McLAREN, P., BARRIE, W.B., and SEMPELS, J.M. - 1981
The coastal morphology and sedimentology of Cape Hatt: implications for the Baffin Island oil spill project (BIOS); *in* Current Research, Part B, Geol. Surv. Can., Paper 81-1B, pp. 153-162.

2201 MILNE, A.R., and HERLINVEAUX, R.H. - 1977
Crude Oil in Cold Water; Beaufort Sea Project Overview Report Series, The Beaufort Sea and the Search for Oil, 119 p.

As continental sources of petroleum are being depleted, attention is being focussed on offshore sedimentary formations. This is particularly true in North America and, in Canada, almost the whole of the continental shelf of the Beaufort Sea has been subject to permits by oil companies for a number of years. Seismic and other geophysical surveys have been carried out over the whole region. Until the summer of 1976, the only drilling which had taken place offshore in the Beaufort Sea had been from artificial islands constructed in shallow water close to the Mackenzie Delta. In 1976, Canadian Marine Drilling Limited (CanMar), a wholly-owned subsidiary of Dome Petroleum, obtained drilling permits for two wildcat wells in the southern Beaufort Sea. An expansion of exploratory drilling, perhaps followed by the drilling of production wells and the laying of pipeline networks, will have environmental and social implications which will have to be dealt with.

Of immediate concern is how the Beaufort Sea region might be degraded by exploratory drilling. The major immediate threat is an undersea oilwell blowout during the exploratory drilling phase. Questions such as: What are the probable consequences of an oilwell blowout? and, what is the capability to control a blowout and to clean up the oil? ... prompted the federal government to postpone the granting of Drilling Authorities in the Beaufort Sea until the results of a regional environmental assessment could be known.

Cabinet, in July 1973, granted Approval-in-Principle for exploratory drilling, using drillships in the Beaufort Sea. However, the Drilling Authority was subject to two riders in the Cabinet decision. These were that the actual drilling would not take place before the summer of 1976; and that the Authority would be issued conditional on constraints which would be determined by the Beaufort Sea Project, which was the name given to the group of studies from which the Assessment would be made.

A unique feature of the Project was its joint government and petroleum industry nature, where industry contributed $4 million of funds to support the Beaufort Sea Project. By the time the Project was completed in late 1976, the total cost was an estimated $12 million. Included in the Project were studies on Wildlife, Marine Life, Oceanography, Meteorology, Sea Ice, and Oilspill Countermeasures. These studies provided ecological baselines, a better understanding of the physical environment, knowledge related to the consequences of a possible oilspill, and methods of oil cleanup in ice-infested water. Reports on these studies - now 46 in number - were published as The Beaufort Sea Project Technical Report Series. They are available to the public, on request and by title, but were written for a specialized audience of consultant engineers, industry and government officials. Part of the information contained in the Technical Report Series has been synthesized in this book, and in the remaining five volumes of the Beaufort Sea Project Overview Report Series.

SEA ICE RESEARCH

2202 ANONYMOUS - 1980
Plotting through the pack - Radar resistant ice; *SCIENCE DIMENSION*, Nat. Res. Council, vol. 12, no. 3, pp. 16-19.

2203 BANKE, E.G., SMITH, S.D., and ANDERSON, R.J. - 1980
Drag Coefficients at AIDJEX from Sonic Anemometer Measurements; *in* Sea Ice Processes and Models, Proc. Arctic Ice Dynamics Joint Experiment, Intern. Comm. Snow & Ice Sym., ed. R.S. Pritchard, Univ. Wash. Press, Seattle, pp. 430-442.

One hundred four data runs of eddy flux measurements of wind stress on Arctic sea ice were recorded at AIDJEX camps in 1971, 1972, 1975, and 1976. Parameterization of the drag coefficient, C_{10}, is proposed in terms of an ice surface roughness parameter. During three AIDJEX experiments good agreement with wind stress from wind profiles was obtained, although there are discrepancies in wind speed. Low drag coefficients have been observed in conditions of highly stable stratification, generally associated with low wind speeds. For 85 data runs with near-neutral stability, generally associated with wind speeds over 6 m/s, the mean drag coefficient is 1.58×10^{-3}. Form drag of pressure ridges was measured by a pressure-differential method.

2204 CARSEY, F.D. - 1980
The Boundary Layer Height in Air Stress Measurement; *in* Sea Ice Processes and Models, Proc. Arctic Ice Dynamics Joint Experiment, Intern. Comm. Snow & Ice Sym., ed. R.S. Pritchard, Univ. Wash. Press, Seattle, pp. 443-451.

The height of the boundary layer, Z_i, as derived from acoustic radar soundings is used to examine wind profiles from pilot balloon tracking. The result is a tentative empirical stress law, seasonal variation of stress and Z_i, and an apparent boundary layer baroclinity which is not reflected in wind shear above Z_i. The stress law is $\tau = \frac{1}{2}\rho f Z_i G \sin \alpha$, where ρ is air density, f the Coriolis parameter, G the geostrophic wind speed, and α the geostrophic-to-surface wind turning angle. Plots are shown of the stress law and the interrelationships of G, Z_i , and α.

2205 COCHRAN, G.V.B. - 1980
Field techniques for experimental stress analysis in Arctic sea ice; *J. Glaciology*, vol. 25, no. 91, pp. 175-182.

Increasing interest is being directed toward studies involving measurement of strain and strain-rates in sea and glacier ice. A number of techniques for obtaining these data over gauge lengths ranging from 1 m to several kilometers have been reported, but there has been little experience with shorter lengths. Use of commercially available electrical resistance strain-gauges (length 5-20 cm) intended for embedment in concrete offers a new approach in which multiple gauge, two- and three-dimensional arrays can be installed in ice with minimum effort and monitored with portable equipment. This report describes a pilot study designed to demonstrate the use of three types of electrical resistance strain gauges in sea ice under exposed field conditions. Results include detection of variations in strain fields related to tidal currents.

2206 COON, M.D. - 1980
A Review of AIDJEX Modeling; *in* Sea Ice Processes and Models, Proc. Arctic Ice Dynamics Joint Experiment, Intern. Comm. Snow & Ice Sym., ed. R.S. Pritchard, Univ. Wash. Press, Seattle, pp. 12-27.

This paper is a review of the development of the AIDJEX model of the dynamics and thermodynamics of sea ice. The model equations including momentum balance, yield surface, elastic-plastic constitutive law, ice thickness distribution, and yield strength are described. Examples of various calculations utilizing the AIDJEX model are presented, together with some comparisons of model output with measured AIDJEX data.

2207 DELKER, C.V., ONSTOTT, R.G., and MOORE, R.K. - 1981
Intermediate results of the radar backscatter study of sea ice in the Beaufort Sea; *in* Proc. Final SURSAT Ice Workshop, Atmos. Env. Serv., Toronto, June 23-27, 1980, eds. R.O. Ramseier and David J. Lapp, Section 5.3, 46 p.

As a part of the Beaufort Sea segment of the Surveillance Satellite Project (SURSAT), a team of investigators from the University of Kansas conducted experiments to obtain quantitative measurements of radar backscatter from sea ice during the month of March 1979. Thick first-year sea ice, thin first-year sea ice, and an inland fresh water lake were studied using a surface-based FM-CW scatterometer that swept from 1.1 - 1.9 GHz and 8.5 - 17.5 GHz with angles of incidence (from vertical) of 10° to 75° and various linear polarizations. Measurements of thick first-year sea ice, thin first-year sea ice, brackish sea ice, and an inland fresh-water lake were also made using a helicopter-borne FM-CW scatterometer that swept from 8.5 - 17.5 GHz with incidence angles of 20° to 60° and VV polarization only.

The 1.1 - 1.9 GHz measurements show that lake ice can be distinguished from thick and thin first-year sea ice. The radar cross-sections of thick and thin first-year sea ice are not significantly different for incidence angles less than 45°. The 8.5 - 17.5 GHz measurements indicate that lake ice can be distinguished from the other types in all cases. Thick and thin first-year sea ice are separated by a 2 - 4 dB difference for incidence angles greater than 40°.

The effect of snow cover on the return from lake ice was also investigated with dramatic results. Returns from bare-surface lake ice were found to be 10 - 12 dB lower than the returns from snow-covered lake ice. This indicates that volume scatter in the snow may be the major contributor to lake ice backscatter when snow is present.

2208 DENNER, W.W., and ASHIM, L.D. - 1981
Operational Determination of Wind Stress on the

Arctic Ice Pack; *in* Sea Ice Processes and Models, Proc. Arctic Ice Dynamics Joint Experiment, Intern. Comm. Snow & Ice Sym., ed. R.S. Pritchard, Univ. Wash. Press, Seattle, pp. 76-88.

Routine forecasting of sea ice drift in the Arctic will require accurate determination of the wind stress field from large-scale atmospheric pressure fields. Fleet Numerical Weather Central (FNWC) at Monterey, California, is responsible for routine numerical forecasting for the Navy. FNWC currently uses a 125 x 125 point polar stereographic projection for many routine analysis and forecast fields. The Navy has some special requirements for ice forecasting which probably can best be met by numerical models such as the AIDJEX model.

In this paper the performance of routine FNWC surface pressure analyses and forecasts in the Beaufort Sea are evaluated for driving an ice model. The wind stress fields determined from the FNWC pressure fields are compared with measurements collected during the AIDJEX experiment. A simulation with the AIDJEX model has been run using FNWC surface pressure analysis fields for the period 15-25 May 1975 and compared with AIDJEX results. Recommendations are made to improve the FNWC fields in the Arctic for application to ice forecasting.

2209 DEY, B. - 1980
Applications of satellite thermal infrared images for monitoring North Water during the periods of polar darkness; *J. Glaciology*, vol. 25, no. 93, pp. 425-438.

The study reported here illustrates the unique value of NOAA thermal infrared (TIR) images for monitoring the North Water area in Smith Sound and northern Baffin Bay during the periods of polar darkness. Wintertime satellite images reveal that, during the months of December through February, open water and thin ice occur in a few leads and polynyas. However, in March, the areas of open water and thin ice decrease to a minimum with a consequent higher concentration of ice. Two ice dams, in northern Kennedy Channel and in northern Smith Sound, regulate the flow of ice into northern Baffin Bay and also determine the areal variations of open water and thin ice in Smith Sound.

2210 DEY, B. - 1980
Orbital Sensing of Mackenzie Bay Ice Dynamics; *Arctic*, vol. 33, no. 2, pp. 280-291.

Satellite images are a useful tool in the study of sea ice dynamics. The results of studies using satellite images of Mackenzie Bay during the break-up and freeze-up periods are presented in maps and tables. These indicate important temporal variations in the processes of bay ice break-up and freeze-up. Though the Mackenzie Bay break-up proceeds from the south and from the north, the southern melt rate is faster because of an influx of warm water from the Mackenzie River. The freeze-up proceeds from south to north, i.e., from the fresh water area to the saline water area of the bay The study of Mackenzie Bay ice dynamics is important because of the barge traffic through the Mackenzie River and also because of offshore drilling activities in the Beaufort Sea.

2211 DEY, B. - 1980
Seasonal and annual variations in ice cover in Baffin Bay and northern Davis Strait; *Can. Geographer*, vol. XXIV, no. 4, pp. 368-384.

The sea ice cover in Baffin Bay and northern Davis Strait is at a maximum in March and at a minimum in September. It depletes rapidly in July and August and grows rapidly during October and November. More annual variations were noticed during periods of ice cover depletion than during ice cover growth periods. The paper presents a sea ice forecast model which is based on annual ice cover depletion and growth data 1968-79 and which should be useful for planning navigation and drilling operations.

2212 DEY, B. - 1980
Variations of August Ice Cover in the Beaufort Sea and Related Weather Conditions; *Bull. American Meteorological Soc.*, vol. 61, no. 3, pp. 213-217.

This note illustrates the relationships between mesoscale weather conditions and the retreat of pack ice edge or expansion of open water in the Beaufort Sea. Strong southeasterly winds in the southern Beaufort Sea and higher than normal surface temperatures appear to be the principal contributing factors to the maximum retreat of polar pack ice and vast expansion of open water.

2213 DEY, B. - 1981
Monitoring Winter Sea Ice Dynamics in the Canadian Arctic With NOAA-TIR Images; *J. Geophys. Res.*, vol. 86, no. C4, pp. 3223-3235.

The study revealed the unique features of winter sea ice dynamics in the Canadian Arctic during 1974-1978 winter seasons. The features included the presence of open water and thin ice in parts of Smith Sound, northern Baffin Bay, western Jones Sound, Foxe Basin, Lancaster Sound, and southeast Baffin Bay. In addition, persistency of leads and polynyas at Smith Sound, Melville Bay, northern Lancaster Sound, Jones Sound, Home Bay, eastern Beaufort Sea, and Amundsen Gulf was remarkable phenomenon. Further, active leads were found in Baffin Bay and Beaufort Sea throughout the winter season. Two ice dams at Smith Sound and Barrow Strait regulated the influx of ice into northern Baffin Bay. The influx of ice into northern Baffin Bay through Smith Sound, Jones Sound, and Lancaster Sound estimated to be 654 km^3 per year, whereas the influx of ice from the Arctic Ocean and the Central Archipelago through Robeson Channel, Fram Sound, and Barrow Strait was about 201 km^3 per year.

2214 DEY, B. - 1981
Sea Ice Cover and Related Atmospheric Conditions

in Arctic Canada During the Summer of 1978; *Monthly Weather Review*, vol. 108, Amer. Meteorological Soc., pp. 2092-2097.

Maps are presented of sea ice cover and open water in the Canadian Arctic for the final day of each month, June-September, 1978. The maps are derived from NOAA satellite imagery and show an extent of open water which is considerably smaller than that in the summers of 1975-77. Areal and temporal variations in sea ice cover and open water in the Canadian Arctic are related to atmospheric conditions particularly the locations of high- and low-pressure cells and the prevailing winds over the region and to melting degree days at four selected stations. The prevailing winds bring warm or cold air masses which increase or decrease air temperatures/melting degree days and consequently speed up or delay the time of ice melting. Moreover, strong prevailing winds depending on whether offshore or onshore take ice away from the coast or push ice toward the coast and thus cause areal variations of open water and ice cover.

2215 DEY, B.B. - 1981
Shipping routes, ice cover and year-round navigation in the Canadian Arctic; *Polar Record*, vol. 20, no. 129, pp. 549-559.

I have divided the following analysis of year-round shipping routes in the Canadian Arctic into two parts: a discussion of ice conditions, in particular during the period of polar darkness, followed by an examination of the type of Arctic icebreaking tanker required for year-round navigation.

2216 HALL, R.T. - 1980
AIDJEX Modeling Group studies Involving Remote Sensing Data; *in* Sea Ice Processes and Models, Proc. Arctic Ice Dynamics Joint Experiment, Intern. Comm. Snow & Ice Sym., ed. R.S. Pritchard, Univ. Wash. Press, Seattle, pp. 151-162.

This paper describes data and results of several remote sensing studies associated with the formulation and testing of the AIDJEX model. The primary source of data was the Landsat satellite, with lesser use made of NOAA images and aircraft photography. Landsat images are used to obtain data about the distribution of thin ice and the deformation of the ice cover. These two types of information have been used separately and in combination to examine the theory and test the performance of the AIDJEX model. Examples show how satellite data can be used to provide initial conditions and verify the results of numerical simulations.

2217 HALL, R.T. - 1980
A Test of the AIDJEX Ice Model Using Landsat Images; *in* Sea Ice Processes and Models, Proc. Arctic Ice Dynamics Joint Experiment, Intern. Comm. Snow & Ice Sym., ed. R.S. Pritchard, Univ. Wash. Press, Seattle, pp. 89-101.

Displacement and strain data obtained from Landsat images have been used to evaluate three numerical simulations of sea ice motion for a region of the Beaufort Sea for 15-25 May 1975. Tests include vector comparisons of the average daily displacement and principal strain at 10 locations in the interior of the model region, four-day cumulative displacements at two points in the interior, and two-day cumulative tests of the boundary motion at two points. Figures of merit calculated for displacement and strain describe the overall improvement at the kinematic response of the model runs.

1952 KATZ, D.I. - 1980
Air Stress Measurements from an Aircraft; *in* Sea Ice Processes and Models, Proc. Arctic Ice Dynamics Joint Experiment, Intern. Comm. Snow & Ice Sym., ed. R.S. Pritchard, Univ. Wash. Press, Seattle, pp. 452-463.

2046 LEWIS, C.F.M. - 1978
The frequency and magnitude of drift-ice groundings from ice-scour tracks in the Canadian Beaufort Sea; *in* Proc. POAC 4th Intern. Conf. on Port and Ocean Engineering under Arctic Conditions, ed. D.V. Muggeridge, vol. 1, Mem. Univ. Nfld., St. John's, Nfld., Sept. 26-30, 1977, pp. 568-579.

1957 MARTIN, P., CLARKE, M., SHORT, D., and ALBRIGHT, M. - 1980
One Year of Barometry on the Frozen Ocean; *in* Sea Ice Processes and Models, Proc. Arctic Ice Dynamics Joint Experiment, Intern. Comm. Snow & Ice Sym., ed. R.S. Pritchard, Univ. Wash. Press, Seattle, pp. 410-418.

1964 PAULSON, C.A. - 1980
A Review of the AIDJEX Atmospheric Program; *in* Sea Ice Processes and Models, Proc. Arctic Ice Dynamics Joint Experiment, Intern. Comm. Snow & Ice Sym., ed. R.S. Pritchard, Univ. Wash. Press, Seattle, pp. 28-33.

2194 PECK, G.S. - 1979
Arctic Oceanographic Survey - 1979, Field Report; *Fisheries & Oceans*, internal report, Ocean and Aquatic Sci., Central Region Field Report Series No. 79-3, 65 p., *UNPUBLISHED MANUSCRIPT*.

2218 PRITCHARD, R.S. - 1980
Sea Ice Processes and Models; Proc. Arctic Ice Dynamics Joint Experiment, Intern. Comm. Snow & Ice Sym., Univ. Wash. Press, Seattle and London, 474 p. ISBN 0-295-95658-5

The forty papers in these proceedings were presented at a symposium on Sea Ice Processes and Models at the University of Washington, Seattle, on 6-9 September 1977. The symposium was sponsored by the Arctic Ice Dynamics Joint Experiment (AIDJEX) and the International Commission on Snow and Ice (ICSI). The symposium was convened to bring together scientists and engineers studying the atmosphere/ice/ocean system in polar regions. It also served to present and review the results of the AIDJEX project -

its swan song, according to local journalists. Over 150 individuals from nine countries attended. They represented numerous government agencies and research laboratories, universities, private research laboratories, and industrial firms.

The papers have been grouped into four sections: AIDJEX review papers; deterministic ice modeling; ice observations; and boundary layers. Each of the last three sections contains both AIDJEX and other research papers. It is hoped that this format will make it possible for the reader to find material on a particular topic more easily.

2219 PRITCHARD, R.S. - 1980
A Simulation of Nearshore Winter Ice Dynamics in the Beaufort Sea; *in* Sea Ice Processes and Models; Proc. Arctic Ice Dynamics Joint Experiment, Intern. Comm. Snow & Ice Sym., ed. R.S. Pritchard, Univ. Wash. Press, Seattle, pp. 49-61.

Ice conditions and motion in the nearshore Beaufort Sea from 27 January to 3 February 1976 were strongly affected by ice stresses. We chose to simulate this response using the AIDJEX model. Both observations and model output show there is no motion during the first two days even though winds are moderately high. When motions begin, they are westward. There is a time lag, with ice in the eastern portion responding later. Near the shore, a fast-ice region exists that is separated from the moving pack by a discontinuity. There conditions are verified by NOAA satellite images and data from drifting buoys and AIDJEX camps. The model is shown to simulate these features accurately, including the velocity discontinuity. This test of the AIDJEX model shows that we understand how ice responds on the large scale to driving forces and are able to describe this relationship at times when the ice stress exerts a dominant influence on the response. This model allows us to use winds (including the large set of historical winds) to determine ice velocity (and trajectories) and to estimate the large-scale average forces that pack ice may exert.

2220 ROSSITER, J.R., BUTT, K.A., GAMBERG, J.B., and RIDINGS, T.F. - 1981
Airborne Impulse Radar Sounding of Sea Ice; *in* Proc. Final SURSAT Ice Workshop, Atmos. Env. Serv., Toronto, June 23-27, 1980, eds. R.O. Ramseier and David J. Lapp, Section 5.19, 8 p.

Airborne impulse radar, operated from helicopter and Twin-Otter, was used in March-April 1979 to estimate the physical properties of sea ice in the Beaufort Sea and Lake Melville, Labrador. Concurrent measurements included: augered thickness, salinity, temperature, crystal fabric, electrical properties of the ice, simultaneous aerial photography, and synthetic aperture radar imagery.

Impulse radar centre-frequency of 80, 100, and 200 MHz were used. A centre-frequency near 100 MHz appears to give the best trade-off of penetration *vs* resolution and antenna size. Data collected below 30 m elevation have reduced side-scatter from the ice surface. Speeds below $50\ m\ s^{-1}$ are required with the current hardware to achieve coherence from scan-to-scan.

Thickness estimates are excellent for fresh and brackish ice, and are good for undeformed first-year sea ice about 1-2 m thick. Areas of fresh water melt pools that have only experienced surface refreezing show thickness profiles that warrant further examination. Bottom returns from multi-year ice are sporadic, although floes up to 14 m have been sounded. Ridges are not usually penetrated, but can be easily detected. Data processing algorithms are under development to characterize the ice further using the strength of the returns. Airborne impulse radar appears useful for routine estimation of the "third-dimension" of ice properties, particularly in conjunction with aerial remote sensing surveys.

2221 ROTHROCK, D.A., COLONY, R., and THORNDIKE, A.S. - 1980
Testing Pack Ice Constitutive Laws with Stress Divergence Measurements; *in* Sea Ice Processes and Models; Proc. Arctic Ice Dynamics Joint Experiment, Intern. Comm. Snow & Ice Sym., ed. R.S. Pritchard, Univ. Wash. Press, Seattle, pp. 102-112.

To test constitutive laws for pack ice, the stress divergence evaluated from first and second spatial derivatives of the ice velocity using a trial constitutive law can be compared with the stress divergence calculated as a residual in the momentum balance. We find sufficient accuracy in the method and in the position and 10 m wind data from AIDJEX to provide a real test of a plastic law with constant yield stress. The law is tested in three cases and rejected.

2222 SADLER, H.E., and SERSON, H.V. - 1981
Fresh Water Anchor Ice Along an Arctic Beach; *Arctic*, vol. 34, no. 1, pp. 62-63.

Anchor ice is broadly defined in the World Meteorological Organization Sea Ice Nomenclature (WMO 1970) as "submerged ice attached or anchored to the bottom, irrespective of the nature of its formation". We discuss here a form of anchor ice of which we can find no previous description.

2223 THORNDIKE, A.S., and COLONY, R. - 1980
Large-Scale Ice Motion in the Beaufort Sea During AIDJEX, April 1975-April 1976; *in* Sea Ice Processes and Models; Proc. Arctic Ice Dynamics Joint Experiment, Intern. Comm. Snow & Ice Sym., ed. R.S. Pritchard, Univ. Wash. Press, Seattle, pp. 249-260.

The average circulation of sea ice in the Beaufort Sea has been generally known, the main feature of this drift being the anticyclonic motion of the Beaufort Gyre. The data set collected during the AIDJEX experiment provides a more complete description of motion and deformation in the Beaufort Sea.

AUTHOR INDEX

Aagaard, K.
2186

Addison, P.A.
1928

Albright, M.
1947, 1957

Alean, J.
2148

Allen, V.S.
2118, 2131, 2132, 2133, 2134, 2143

Alt, B.T.
1948,

Anderson, J.C.
2172, 2173

Anderson, R.J.
2203

Andriashek, D.
1910, 1911, 1914

Anonymous
1966, 1974, 1995, 1996, 2161, 2202

Arnold, C.D.
1814, 1815, 1816

Ashim, L.D.
2208

Badone, E.
1819

Balkwill, H.R.
2102

Ballantyne, C.K.
2174

Banke, E.G.
2203

Barrie, W.B.
1879, 1997, 2065

Barry, S.J.
1855, 1856

Barry, T.W.
1856, 1874

Barsch, D.
1998, 2149

Batten, J.
2162

Beardmore, R.M.
1975

Bell, K.L.
1929, 1930, 1931

Bellegay, R.D.
2200

Berger, P.
1959, 2150

Biefer, G.J.
1976, 1977, 1978

Bielawski, E.
1817, 1818

Birkhead, T.R.
1857, 1858, 1886

Blachut, S.P.
2175

Blake, Jr., W.
1999, 2000, 2001, 2002

Blasco, S.M.
2003

Blatter, H.
1958

Bliss, L.C.
1928, 1929, 1930, 1931, 1932, 1933, 1934

Bonardi, M.
2004

Bornhold, B.D.
1997, 2003, 2004

Bowerman, S.
1979

Boyd, H.
1887

Bradley, R.S.
1949

Brand, U.
2005, 2006, 2007, 2008

Brooks, D.J.
2187

Brown, R.G.B.
1859

Bruemmer, F.
1860, 1980

Burgess, M.
2118, 2119, 2120, 2129, 2131, 2132, 2133,
2134, 2143

Burnip, M.
1841, 1842

Burns, R.A.
2125, 2126, 2127

Burrous, C.
2051

Butt, K.A.
2220

Calvert, W.
1910, 1911, 1914, 1916

Camfield, P.A.
2121

Campbell, F.H.A.
2009

Carsey, F.D.
2204

Chandler, F.W.
2010, 2011

Charbonneau, B.W.
2010

Ciesielski, A.
2010

Clarke, G.K.C.
2151

Clarke, M.
1957

Cleator, H.
1918

Cochran, G.V.B.
2205

Cole, S.
1817, 1818

Colony, R.
2221, 2223

Cooch, F.G.
1887

Coon, M.D.
2206

Corlett, M.I.
2063, 2064, 2096

Costaschuk, S.M.
2012

Courtin, G.M.
1935

Cumming, L.M.
2037

Cwynar, L.C.
1936

Davies, G.R.
2079

Davies, P.V.
1967, 2167, 2168

Dawson, M.R.
2116, 2117

DeLaurier, J.M.
2121

Delker, C.V.
2207

DeMaster, D.P.
1861, 1862, 1910

Denner, W.W.
2208

Dey, B.
2122, 2209, 2210, 2211, 2212, 2213, 2214, 2215

Dixon, O.A.
2013, 2075, 2086

Doake, C.S.M.
1968

Dunbar, M.J.
2188

Dunn, B.P.
1994

Dupuis, P.
1888, 1889

Dyke, A.S.
2014, 2015, 2016, 2017

Dyke, L.D.
2018

Dyson, J.
1981, 1982

Edlund, S.A.
1940

El-arini, M.B.
1986

England, J.H.
1949

Erickson, P.
2200

Ferguson, R.
1841

Fischer, K.
1888

Fisher, D.A.
1950, 1954, 1955, 1956, 1970, 2152, 2154

Forbes, D.L.
2085

Forsyth, D.A.
2020

Franklin, U.M.
1819

Fraser, I.
2020

Freedman, B.
1944

French, H.M.
2021, 2022, 2023, 2024, 2025, 2026, 2027, 2031, 2090

Frisch, T.
2028, 2104

Fritz, P.
2071, 2072

Fushimi, H.
1983

Gagné, R.M.
2029, 2126, 2127

Gamberg, J.B.
2220

Gaston, A.J.
1863, 1886

Gell, A.W.
2173

Geraci, J.R.
1864, 1865

Gibling, M.R.
2074, 2076

Gizyn, W.I.
1937

Glazier, G.T.
1912

Good, R.L.
2125

Goodman, R.H.
2158

Gordey, S.P.
2030

Gorman, M.
1968

Gotthardt, R.
1819

Gray, D.R.
1866, 1867

Greendale, R.G.
1898

Gunn, A.
1868, 1869, 18[illegible] 1923

Hall, R.T.
2216, 2217

Hammill, M.O.
1901, 1902, 1905, 1906

Harper, M.F.L.
2145

Harrison, T.E.
2125, 2126, 2127

Hartgerink, A.P.
1938

Havas, M.
1939

Hawkins, J.P.
2126, 2127

Hay, K.A.
1870, 1898

Hayward, M.
2031

Hélie, R.G.
2032

Helmer, J.W.
1820, 1821

Herlinveaux, R.H.
2201

Heron, R.
2183, 2185

Hickey, C.G.
1822

Hickey, L.J.
2117

Higuchi, K.
1983

Hobson, G.D.
1951, 1984, 1985, 2033, 2123, 2163

Hodgson, D.A.
1940, 1997, 2034, 2035

Hood, P.J.
2124

Hunkins, K.L.
2189

Hunter, G.
2164

Hunter, J.A.M.
1819, 2123, 2125, 2126, 2127

Hutchinson, T.C.
1941

Iannelli, T.R.
2036

Ikegami, K.
1983

Internav Ltd.
1969

Ito, H.
1959

Jackson, G.D.
2036, 2037

Jacobson, B.
1856

Joly, P.
1922

Jones, B.
2013, 2038, 2039, 2040, 2041, 2042, 2043, 2074, 2076

Jonkel, C.J.
1871

Jubb, R.G.
1997

Judge, A.S.
1619, 2118, 2128, 2129, 2130, 2131, 2132, 2133, 2134, 2141, 2142, 2143

Karasiuk, D.J.
1927

Katz, D.I.
1952

Keys, J.E.
2188

Kiliaan, H.P.L.
1881, 1882, 1911, 1915

King, L.
1998

Kingsley, M.C.S.
1861, 1916

Klassen, R.A.
2044

Koerner, R.M.
1942, 1950, 1953, 1954, 1955, 1956, 1970, 2152, 2153, 2154

Kolenosky, G.B.
1871

Konishchev, V.N.
2049

Kroeger, P.
1920

Krupicka, J.
2045

Kuja, A.
1941

Lake, R.A.
2190, 2191, 2192

Langleben, M.P.
1773, 2193

Lee, R.K.S.
1943

LGL Ecological Research Associates Inc.
1872

Lehn, W.H.
1986, 1987, 1988, 1989, 1990

Lewis, C.F.M.
2003, 2046, 2047

Lewis, C.P.
2060

Lewkowicz, A.G.
2027, 2048

Lorrain, R.D.
2155

Lutz, A.
1924

Lyons, J.A.
2061

Maag, H.U.
2156

MacAulay, H.A.
2123, 2126, 2127, 2135

Macdonald, S.
1971, 2169

Macdonald, R.W.
2200

MacDonald, S.D.
1873

MacInnis, J.B.
1991

Mackay, J.R.
2049, 2050, 2051, 2052, 2053, 2054, 2055, 2056, 2057, 2058, 2059, 2060

Mair, J.A.
2020, 2061

Mandarino, J.A.
2062, 2063, 2064, 2095, 2096

Marsh, P.
2176, 2177

Martell, A.M.
1878

Martin, M.
1874

Martin, P.
1957

Martin, S.K.
1875

Mary-Rousselière, G.
1823

Maurice, V.T.
2010

Mayfield, H.F.
1876, 1877

Mayo, J.M.
1935, 1938

Mayr, U.
2103

McCann, S.B.
2174, 2175

McCartney, A.P.
1824, 1825, 1826, 1827, 1828, 1829

McCartney, N.G.
1830

McCullough, K.
1849

McDonald, E.J.
1878

McGhee, R.
1831, 1832, 1833, 1834, 1835, 1836, 1837,
1838

McLaren, P.
1879, 1997, 2065, 2066, 2067

Medendorp, J.
2169

Miall, A.D.
2068, 2069, 2070, 2117

Michel, F.
2071, 2072

Miles, M.
2085

Miller, F.L.
0962, 1868, 1869, 1880, 1881, 1882, 1921

Miller, S.
1871

Milne, A.R.
2201

Mogg, M.I.
2165

Monahan, D.
1854

Moore, P.R.
2073

Moore, R.K.
2207

Morrison, R.I.G.
1883, 1884, 1885, 1926

Moser, J.
1888

Muller, F.
1958, 1959, 1961, 1962, 2148, 2150, 2156,
2157, 2158, 2160

Muller-Beck, H.
1839, 1840

Narbonne, G.M.
2013, 2041, 2074, 2075, 2076, 2077, 2078

Nassichuk, W.W.
2079

Neave, K.G.
1619, 2123

Nettleship, D.N.
1857, 1858, 1859, 1886

Niblett, E.R.
2121

Nixon, F.M.
1972, 1973

Norris, D.K.
2080, 2089

O'Connor, M.J. & Associates Ltd.
2081, 2082, 2083, 2084

Ohmura, A.
1958, 1959, 1960, 1961, 1962, 1963

Oldershaw, A.E.
2041

Ommanney, C.S.L.
2158

Onstott, R.G.
2207

Owens, E.H.
2085

Packard, J.J.
2042, 2086

Padgham, W.A.
2087

Parker, G.R.
1921

Parnandi, M.
1970

Paterson, W.S.B.
2151, 2159

Paulson, C.A.
1964

Payne, D.
2166

Peck, G.S.
2194, 2195, 2196, 2197

Pelletier, B.R.
2088, 2089, 2108

Phillips Parmenter, C.
1841, 1842, 1843, 1844

Plant, A.G.
2092

Plet, F.
2121

Pollard, W.H.
2090

Popov, A.I.
2049

Prach, R.W.
1887

Pritchard, R.S.
2218, 2219

Redman, J.D.
2137

Reed, A.
1888, 1889

Reichle, R.
1907

Richards, J.H.
2122

Ridings, T.F.
2220

Ring, R.A.
1890, 1891, 1892

Ritchie, J.C.
1936

Robertson, B.T.
2091

Robertson, P.B.
2092

Robertson, R.J.
1871

Rossiter, J.R.
2137, 2220

Rothrock, D.A.
2221

Rouse, W.R.
2176

Rowell, J.
1893

Russell, R.H.
0962, 1921

Rutledge, L.
2119, 2130

Rydén, B.E.
2178

Sadler, H.E.
2222

St. Aubin, D.J.
1864

St. Jacques, D.A.
2198

Sandilands, R.W.
2170

Saskatoon Star-Phoenix
1992

Sauriol, J.
2181, 2184

Savelle, J.M.
1845, 2093, 2094

Schledermann, P.
1846, 1847, 1848, 1849

Schriber, G.
2157

Schroeder, I.I.
1989

Schroff, K.
1958, 1959

Scott, W.J.
2136

Scotter, G.W.
1927

Sempels, J.M.
1879, 2065

Serson, H.
2222

Short, D.
1957

Sieffert, R.A.
1879

Silverman, H.B.
1894

Siniff, D.B.
1907

Sleno, G.A.
1897

Smith, M.W.
2022, 2023

Smith, S.D.
2203

Smith, T.G.
1864, 1865, 1895, 1896, 1897, 1898, 1899,
1900, 1901, 1902, 1903, 1904, 1905, 1906,
1907, 1918, 1993

Solvason, R.R.
2198

Souchez, R.A.
2155

Stablein, G.
2149

Stauffer, B.
2157

Steer, P.
1965, 2183

Steffen, K.
1958, 1959, 2160

Stephenson, F.E.
2171

Stevens, R.D.
2011

Stich, H.F.
1994

Stirling, I.
1861, 1862, 1871, 1908, 1909, 1910, 1911,
1912, 1913, 1914, 1915, 1916, 1917, 18

Stone, S.
1907

Strangway, D.W.
2137, 2138

Sturman, B.D.
2062, 2063, 2064, 2095, 2096

Sutcliffe, A.J.
1919

Sutherland, P.D.
1850

Svoboda, J.
1944

Swales, D.E.
1945

Sweeney, J.F.
2139

Tait, B.J.
2198

Taylor, A.E.
2129, 2130, 2131, 2132, 2133, 2134, 2140,
2141, 2142, 2143

Taylor, D.
1897, 1898

Taylor, J.D.
1975

Taylor, R.B.
1879, 1997, 2085, 2097, 2098, 2099, 2100

Tesar, D.
1890, 1892

Thomas, D.C.
1869, 1920, 1921, 1922

Thomson, D.
1879

Thorndike, A.S.
2221, 2223

Thorsteinsson, R.
2101

Tilley, B.J.
2036

Tison, J.L.
2155

Trettin, H.P.
2102, 2103, 2104, 2105, 2106

Tummers, E.L.
2199

Uemura, N.
1983

Uyeno, T.T.
2107

Veillette, J.J.
1972, 1973

Veizer, J.
2005, 2006, 2008

Vilks, G.
2108

Vincent, D.
1923

Vincent, J-S
2109, 2110, 2111

Vinson, T.E.
2112

Vitt, D.H.
1946

Voyce, J.
1984, 1985

Wade, B.J.
1851

Wagemann, R.
1924

Wagner, F.J.E.
2108

Walford, M.E.R.
2144, 2145

Wallace, R.R.
1912

Watts, S.H.
2113, 2114

Weber, J.R.
2115, 2146, 2147

West, R.M.
2116, 2117

White, S.
2010

Williams, S.R.
1925

Witts, B.
1926

Wong, C.S.
2200

Woo, M-K.
1965, 2176, 2177, 2179, 2180, 2181, 2182, 2183, 2184, 2185

Yorath, C.J.
2089

Yorga, B.
1819, 1852, 1853

Young, F.G.
2089

Zoltai, S.C.
1927, 2015